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EDISON ELECTRIC INSTITUTE BULLETIN

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PUBLISHED MONTHLY BY EDISON ELECTRIC INSTITUTE

THE ELECTRIC LIGHT AND POWER INDUSTRY

Current Statistical Data Covering 100 Per Cent of Industry

August, 1942 and 1943

SOURCE AND DISPOSAL OF ENERGY—MONTH OF AUGUST

	1943	1942	%
GENERATION* (Net)			
By Fuel Burning Plants	13,312,286,000	10,958,500,000	+21.5
By Water Power Plants	5,885,499,000	5,317,500,000	+10.7
Total Generation	**19,197,785,000**	**16,276,000,000**	**+18.0**
Add—Net Imports Over International Boundaries	141,605,000	109,800,000	+29.0
Less—Company Use	322,867,000	187,200,000	+72.5
Less—Energy Used by Producer	662,365,000	310,000,000	+113.7
Net Energy for Distribution	**18,354,158,000**	**15,888,600,000**	**+15.5**
Losses and Unaccounted For	2,474,299,000	2,238,373,000	+10.5
Sales to Ultimate Customers	**15,879,859,000**	**13,650,227,000**	**+16.3**

CLASSIFICATION OF SALES

NUMBER OF CUSTOMERS—As of August 31st			
Residential or Domestic	26,832,206**	26,471,924	+ 1.4
Rural (Distinct Rural Rates)	1,085,175	1,097,040	.....
Commercial or Industrial:			
Small Light and Power	4,155,506	4,271,672	− 2.7
Large Light and Power	146,859	148,903	
Other Customers	116,983	121,228	.....
Total Ultimate Customers	**32,336,729**	**32,110,767**	**+ 0.7**
KILOWATTHOUR SALES—During Month of August			
Residential or Domestic	2,218,663,000**	2,104,059,000	+ 5.4
Rural (Distinct Rural Rates)	365,808,000	386,312,000	− 5.3
Commercial or Industrial:			
Small Light and Power	2,478,386,000	2,328,002,000	+ 6.5
Large Light and Power	9,223,696,000	7,715,884,000	+19.5
Street and Highway Lighting	154,569,000	150,799,000	+ 2.5
Other Public Authorities	801,987,000	376,486,000	+113.0
Railway and Railroads:			
Street and Interurban Railways	351,426,000	327,809,000	+ 7.2
Electrified Steam Railroads	209,120,000	194,531,000	+ 7.5
Interdepartmental	76,204,000	66,345,000	+14.9
Total to Ultimate Customers	**15,879,859,000**	**13,650,227,000**	**+16.3**
Revenue from Ultimate Customers	**$254,730,100****	**$238,059,100**	**+ 7.0**

RESIDENTIAL OR DOMESTIC SERVICE

AVERAGE CUSTOMER DATA—For the 12 Months Ended August 31st			
Kilowatthours per Customer	1,053	1,013	+ 3.9
Average Annual Bill	$38.43	$37.38	+ 2.8
Revenue per Kilowatthour	3.65¢	3.69¢	− 1.1

(*) By Courtesy of the Federal Power Commission.
(**) Above data reflects results of bi-monthly billings on part of certain large companies.

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EDISON ELECTRIC INSTITUTE BULLETIN

Volume 11 NOVEMBER, 1943 No. 11

Postwar Loads from a Sales Viewpoint

By J. F. Gaskill

Sales Manager, Philadelphia Electric Co.

Presented before a joint session of the Electrical Equipment Committee, EEI, and the Transmission and Distribution Committee, EEI, Chicago, Oct. 8, 1943

THE conditions which will govern the level of postwar loads and their growth do not lend themselves to specific analysis with any great hope of dependable conclusions. Reasonable assumptions with respect to the influences which will prevail can be made, but, unfortunately, the situation with respect to artificial controls is such that reasonable assumptions reveal conditions which are violently opposed insofar as their effect on the economic system is concerned. Furthermore, the timing and magnitude of some of these are indeterminate because they will become effective in a greater or less degree through the decision of individual men.

This is something comparatively new in the American economic system. Until the last two decades, business conditions were determined by the rise and fall of the tides of human needs, desires and purchasing power. Society was served by a system producing goods and services which operated with selling prices and costs sufficiently flexible to respond to the rise and fall of those tides. With the withdrawal of rationing, it is true that selling prices will again become subject to the desire of the public to purchase. I think it is also true that, to a great and growing degree, our production and distribution system has been and will, probably, be subjected to a higher and higher degree of control by external forces which decree that costs are free to go up, but not down. The only factor which alleviates this situation is the ingenuity and inventiveness of our management, research and technical groups, who are dedicated to the idea of finding better products and more economical ways of making them.

This factor is our greatest single hope of retaining some flexibility of costs which will permit their adjustment to the selling prices at which trade will flourish. Obviously, business ceases just as water ceases to flow over a dam when the selling price falls below a rising dam of inflexible costs. It is also obvious that an economic system in which all of the factors, which enter into costs as well as selling price, are not free to respond to the demands of the people for the goods or services involved is not a truly "free enterprise" system. A very great American once said that no nation can exist half slave and half free. This may be true also of economic systems.

I submit this thought for your consideration because it has a very important bearing on the number of kilowatthours and kilowatts which can be disposed of after the war if the tremendous use of credit, in which we are now indulging through the necessity of war, is curtailed. We are all, with the exception of the farmer, entirely dependent upon the volume of trade which can be supported by the ability of the people to satisfy their wants with their purchasing power and the ability of our producing systems to meet, with their costs of operation, the selling prices dictated by the purchasing power of the people.

Optimistic estimates of future business based upon the wants and desires of people without regard to the costs of producing those wants are misleading in the extreme. The wants and desires of the people have always been greater than their purchasing power. These desires are satisfied to the greatest possible extent commensurate with the progress we have made when purchasing power comes to a balance with the cost of producing the goods and services involved.

Therefore, a consideration of the volume of trade that will be supported by the balance between purchasing power and prices is the prime consideration in determining the level of business after the war rather than a consideration of the goods and services available, or what somebody says he will buy next. It is evident, to all of us, I think, that the level of business will determine our loads at that time. Unfortunately, or fortunately, as you may view the picture, the rigidity in cost structures, together with unbalance and reduced volume of trade resulting therefrom can be obscured by the use of credit. We have had some experience with this method during the 20's when commercial credit was used for this purpose, and during the 30's when we saw the effect of the use of Government credit. Therefore, if you could tell me the degree of basic unbalance which will exist because of inflexible costs and the degree and effectiveness to which credit will be used in the postwar period to disguise that unbalance, it would be very much easier to predict load levels.

These thoughts lead me to suggest to you that, at the end of the war on both fronts, we can assume the following:

1. That, since credit has been used for the purpose of correcting unbalances during the decades of the 20's and 30's, its use will be continued after the war until it is restricted in one way or another. It is also reasonable to assume, I think, that this use of credit will be divided between domestic projects and projects for the rehabilitation of foreign countries prostrated by the war.

2. That this period will last long enough to make it unnecessary to discuss, in this paper, the situation which may develop upon the cessation of the use of credit to stimulate the volume of trade.

3. That high taxes and the elimination of fantastic wartime wages will reduce available purchasing power.

4. That the dislocation and delays attendant upon the conversion of production to peacetime needs and the time needed to absorb the returning men from the Armed Forces will have a retarding effect on business.

5. That the savings in bonds or other media will be available to increase purchasing power to the extent to which they can, feasibly, be absorbed.

6. That the introduction of new applications and better products will be extremely helpful, but will also cause some adjustment because of change in the location and methods of production and their effect on employment.

7. That the utility industry, being highly developed at the end of the war, will not have the opportunity to add large increments of new load such as those which followed the last war, but will be forced to more completely electrify the processes of existing customers in all phases of our business.

This indicates smaller increments of load, greater knowledge of the processes of industry by utility men, more exact technical knowledge of applications, and a much more rapid rate of selling in the large commercial and industrial market if we are to maintain the volume of sales to which we have become accustomed.

8. That there is a very real opportunity for the utility company to develop almost indefinitely along these lines because it is the most flexible, the cleanest and most compact source of power, light and heat available.

9. That war load, to a large extent, will disappear.

10. That the disappearing war load will be replaced to a certain extent by the rebound to satisfy civilian requirements which lie like a coiled spring beneath the restrictions, regulations and conversion for the war effort.

Now I know that you, as engineers, would like to know the expected volume of load on each distribution feeder in order that you might plan transmission and distribution networks for the future. If I were prepared to leave the country shortly, I could assume the mantle of a prophet and speak to you with some assurance on this matter, but I do not believe that any man, in the light of the conflicting factors which will control, can make any determination as to volumes of load which will have any more than an accidental hope of realization.

I do believe, however, that the problem can be considered from a maximum and minimum viewpoint. We can, I think, discard the minimum because minimum volume of trade would not affect the particular problem which is your concern, although it might easily have a very important effect on your job and my job and upon the dispositions of our executives. The maximum condition, however, is a matter of considerable concern to you in that you wish to be prepared for increased demands if they occur. The problem then reduces itself to the question as to whether or not we may expect greater loads in the early years of the postwar period than we had during the war.

There are not so many conflicting factors when we consider maximum conditions because it takes time to produce and install the facilities necessary to create additional demands, and the magnitude of the war load loss in the industrial phase of our business will be a compensating factor in the first few years after the war. Furthermore, many of the new products of which we hear, which have been developed as a result of the stimulation by war requirements, are now being made for war purposes and the mere diversion of these products to civilian use will not result in increased loads, and may probably result in a decrease because the overall requirements of peace are notoriously less than those of war.

For example, you may lose the entire load on Feeder No. 2123 when the war ends. If the load is not converted to supply civilian requirements, that's too bad but you have no load problem. If, in the course of the postwar period, this particular load is converted to peacetime uses, the chances are very great that the demand will not exceed that of wartime operation. There will, of course, be exceptions to this, but they should not be numerous.

Feeder No. 2124 may be loaded to capacity by the mixed civilian and war loads of several customers. As the war loads go down, the civilian requirements will rise. It is possible that the peacetime load will rise faster than the wartime load descends. This, of course, is a function of the proportion between the wartime and peacetime loads, the rate at which the wartime load is allowed to descend and the volume of trade which will support the increase in the peacetime load. By and large you should be safe if the normal peacetime load on the feeder is considerably below the wartime level. It would seem to me that a survey would help in determining the expectancy in this respect. Doubtless this has already been done by you.

Feeders which have always been used, exclusively, for the production of civilian needs, the loads of which could not be converted to war use, may exist at certain points. These are now underloaded and should offer no immediate problem after the war. I feel that commercial circuits are in this class because the customers have been subjected to various restrictions, regulations and voluntary reductions covering the use of light, hours and time of use, and equipment purchases together with losses in manpower which should disappear after the war. Lighting is a large proportion of the load in this commercial classification and, while levels of illumination will be increased, any rapid rise over normal peacetime loads will be very definitely slowed down by the inadequacy of the customers' internal wiring. (This is particularly true of hotels, office buildings and such large commercial units.) The degree to which customers, subjected to regulation and restriction, become habituated to doing with less is also a factor of importance in considering the return of load lost during the war.

The growth of the residential load will be definitely influenced by the individual's purchasing power and the selling price of applications. Large numbers of people will undoubtedly leave the areas now stimulated by tremendous wartime production leaving available for the normal population growth the housing, such as it is, which was built by private capital or directly by the Government to house the increment of wartime population. The fantastic wages which have prevailed during the war should tend downward. The improvement in transportation, in roads and in the conveniences available in semi-rural and suburban areas creates a pressure leading to larger increases in population in the suburban rather than the urban areas. In the case of our own company which should not be unique, by far the larger number of new houses has been built in suburban areas over the past two years. On the other hand, the applications which will be available to residential customers, such as the range and water heater, represent large percentage increases on existing loads, while improved efficiency of refrigerating equipment, which now has a very large replacement market, reduces the expectancy of large increases in load from this

application. Because, however, of the comparatively heavy duty equipment available for sale and because housing is a rather obvious outlet for the use of credit, I believe there is more opportunity for exceeding feeder capacities in residential areas than in either the commercial or industrial classifications.

Heavy industry will generally drop back to single shift operation. In this connection, however, I would point out that this factor should reduce the evening system peaks, because, in general, three shift operation imposes a higher load across such system peaks than single shift operation while the effect on the feeder peak should be no greater than that in wartime when all facilities operated at maximum load.

Competition will be a further brake on the increase in industrial, commercial and residential loads because, with the exception of light, the sale of new applications in these classifications of business must be made in competition with other fuels and methods. The severity of this competition varies, of course, with the different applications.

Furthermore, our existing load will undoubtedly be attacked with second-hand equipment and power plants, as well as new equipment and prime movers available at low cost through the operation of war plants purchased at distress prices. The war stimulated improvements in the Diesel engine and the application of the topping turbine in existing plants, where we enjoy only partial load because of the use of process steam, are also factors which we will have to meet in our industrial and commercial classifications.

I also suggest to you that all of these things can be reasonably assumed to apply during the period which may obtain between the end of the war in Europe and that in the Pacific. The difference between the two steps in reaching the end of the war effort will be in degree rather than in kind, and will furnish a transition period which may be helpful insofar as overall business conditions are concerned.

The war effort, if reduced in this period, will release an equivalent amount of material and labor to civilian production. I suggest, however, that, since we will be using the material and facilities to the maximum possible degree during the war, the mere transfer of these items from war work to peace work should not result in more overall load for the country as a whole unless additional materials and facilities become available. Individual systems may find themselves caught between the rising tide of civilian production and a war load retained because of type of product and the relation to supply routes. I have no doubt that you have already considered and analyzed this possibility very completely.

I believe that this brief analysis lends some foundation to the thought that the first few years after the war in Europe should exhibit the following conditions with respect to existing loads:

(1) An industrial load descending from the peak of the war effort. This loss should be modified, but not compensated for, by ascending civilian and foreign requirements production. It is reasonable, I think, to assume that a plateau will be reached some time during this period through these conflicting trends.

This conclusion should be considered in the light of the exceptions mentioned above with respect to systems and lines holding their war load for special reasons.

(2) A rebound, I hope, of the commercial load to normal levels because of the elimination of regulations and restrictions. It is quite possible that this desirable goal will not be reached for some time because of the habits formed while doing with less.

(3) The residential load, not being subject in the same degree to the violent war influences affecting the commercial and industrial classifications, should not vary, greatly, from the level of that obtaining during the war.

(4) Overall system demands of existing loads, with due regard to the exceptions noted, should not be appreciably greater than those of the war period and may easily be less. How much less is beyond prophecy because they will be dependent upon so many conflicting conditions whose magnitude and timing are indeterminate.

All these suggestions should be considered in the light of the use of credit. Peculiar and possibly difficult situations with respect to specific areas and loads may develop if credit is used to maintain war production in the name of employment. A radically different picture would obtain if credit is used to support civilian production only, while war production collapses for lack of demand. I think you will agree that the ramification of possibilities between these extremes makes the whole problem indeterminate. The time required to create new facilities and additional materials, together with the growing consciousness of debt and taxes, leads me to suggest that there is more opportunity for a result comparable to the conclusions offered than for more extreme conditions. The possibility cannot, however, be ignored.

From the levels so assumed, it seems to me that the next problem which should interest you is the question as to whether enough can be sold, in these few years we are considering, to radically affect this picture. Unfortunately, there are two obstacles to a detailed discussion of this point.

First—The studies we are making of our market in Philadelphia are still in progress so that conclusions from an individual and special viewpoint are not available to me.

Second—Even if they were, I am sure you will agree, and are acting on the thought, that the answer to this question can only be found in your individual systems.

I can, however, suggest that it might be helpful to consider four things if you will be kind enough to remember that the thoughts given are, naturally, generated by close contact with a particular system:

(a) The isolated plant market in industrial work is now comparatively small so that concentrations of heavy new loads should be less prominent.

I think it reasonable to assume that, on account of the heavy expansion during the war, few new plants will be built. Therefore, the bulk of industrial sales, as mentioned before, should occur as comparatively small increments of load in existing plants. For this reason, I believe that the new load we will be able to obtain will be widespread, will absorb some of the capacity of existing war feeders and will create few additional extensions in the period in question. Our main sales problem in this work is to so organize and operate that we will have an adequate knowledge of the multitude of applications, equipment and processes.

(b) The commercial load has always been more widespread than the industrial. The increments of new load are small, the areas in which the bulk of it is located are fairly well defined, and it has, on the whole, considerable stability from our viewpoint. It is true that there is an accumulated demand among these customers because they have been unable to purchase equipment during the war.

(*Continued on page* 350)

Tax Exemption Threatens Free Enterprise

By G. C. Neff

President, Wisconsin Power & Light Co.

SOMEONE has said that the power to tax is the power to destroy. Some of our leading tax experts believe that the free enterprise system, which fosters privately-owned business, is in danger of passing out of the picture because of excessive taxation.

We all agree that in this emergency everyone should pay high taxes. However, it is equally important that the taxes on our companies be held down to a level where we can continue to finance and operate our business. This is fundamental, important, and even vital to our continued existence. The present picture of business corporations in this country is not too bright, because of the heavy taxes business is now paying. The picture is made much darker by the ever increasing threat of "TAX FREE" competition of government-owned plants (federal, state, and municipal).

According to an address by Jesse Jones, Secretary of Commerce, broadcast over the Blue Network in July, 1943, the federal government has spent probably twenty-five billion dollars in building plants and facilities of one kind and another. The title to most of these properties is in the government. He states that while much of this money has gone into purely military construction, a great deal of it has gone into plants which can be employed after the war and which will have to be employed if we are to keep men at work. The following table shows the investment of the federal government in plants and facilities.

2½ billion dollars in the electric utility field.

1 billion dollars in the steel industry.

¾ billion dollars in the aluminum business.

½ billion dollars in the manufacture of magnesium.

2/3 billion dollars in the rubber industry.

Almost half of the total machine-tool industry.

2.7 billion dollars in the aircraft business.

½ billion in the gasoline industry.

The above is not a complete list by any means but indicates the extent to which the federal government now owns plants and facilities which can be converted to peacetime operation.

Under our present laws these government-owned activities are tax free, and no one is advocating the taxing of these properties as long as they are devoted almost entirely to the manufacture of war materials and supplies. However, they are not limiting themselves to that field. For example, the 2½ billion dollar government-owned electric utility venture now carries on exactly the same kind of business as does the privately-owned utility industry. Yet this government-owned utility industry is not paying one cent of federal taxes for the support of the war. These tax exempt properties constitute a threat to the free enterprise system.

During the last world war the government built Muscle Shoals to make fertilizer and chemicals for munitions, and no one can have any objection to this kind of a development. But after the war the government continued to own Muscle Shoals, and out of it grew T.V.A., a billion dollar government investment, which pays not one cent in federal taxes for the financing of this war. I doubt very much if there would be a T.V.A. today if there had not first been a Muscle Shoals. The same thing that happened at Muscle Shoals can happen in the steel industry, the rubber industry, the aircraft industry, etc.

It is important that something be done now to make sure that when these government-owned properties quit making supplies for the army and navy and enter the field of private business, they shall be made to pay taxes in exactly the same manner as the privately-owned companies in the same fields have to pay.

There is a well organized group in this country which has a definite plan to destroy the free enterprise system as we understand it and put in its place a government-owned system which will be operated by government employees. If supporters of the free enterprise system permit those who would destroy that system to have the advantage of paying no taxes on the government business for a few years, they can ruin any business with which they compete and take it over at a low price. They can thus bring about national socialism of industry without passing specific laws on that question.

In the electric utility business, the difference between the taxes actually paid by privately-owned companies and what they would pay if they were taxed like government-owned utilities is more than their total payroll. No business can successfully compete with another that has such a big advantage. The main attack against the free enterprise system has been on the utility business. When and if this attack is successful, the attack will be turned on some other large industry of the free enterprise system. Unless all business gets together and opposes these attacks regardless of who is being attacked, the chances of success of the group that wants national socialism of business are good.

There is no logical reason why government-owned business competing with private business either directly or indirectly should be tax exempt. All business ventures in the same field should be taxed on the same basis, regardless of ownership. The supporters of the free enterprise system should not pass up any opportunity to attempt to take away from our opponents any unfair advantage they now have.

It seems to me that we have an opportunity at this time when the Treasury Department is advocating a still higher income tax rate on corporations, which are now very heavily taxed. We should point out that the present corporation tax rates should not be further increased until such time as the government-owned business ventures are made to pay Federal Income Taxes. In other words, no part of business should be taxed to the breaking point while similar business owned by the government is paying no taxes at all.

The old argument that there is no point in taxing a government business because it is just like taking money from one pocket and putting it into another falls down when the government business sells a product or service to the public in the same way that private business sells these things to the public. Through the heavy taxation of corporations the government has made tax collectors out of these corporations. A considerable portion of the sale price of products or service sold is collected from the purchaser for the payment of taxes. In the case of the electric utility industry, 25c

out of every dollar collected is for the purpose of paying taxes, and a major portion of this tax money goes to the federal government.

Under our present laws, the customer of a federal, state, or municipally-owned electric utility pays nothing for federal taxes in his electric bill. In other words, the federal government has forced the privately-owned companies to collect federal taxes from their customers but has exempted government-owned utilities from collecting money for the payment of federal taxes from the customers of such government-owned utilities. The types of customers served by both groups are the same, the kind of property used to furnish the service is similar, and there is no rhyme nor reason why the customers of both groups should not be treated the same in this question of taxation.

If government-owned electric utilities paid all taxes on the same basis as privately-owned electric utilities do, then all customers receiving electric service in this country would contribute to the support of the war through taxes included in the electric bill on the same basis, and the federal government would receive millions of dollars of additional revenue, which would be paid by the customers of government-owned utilities. It is not a question of taking money out of one pocket and putting it into an other. It is new money in the federal treasury.

This same line of reasoning applies to every case where the government goes into any business and sells a product or a service to individual customers. There isn't any reason why the charge for that service should not include a charge for federal taxes in exactly the same way that it is necessary for a privately-owned business to make such a charge.

In the electric utility business, the federal government has seen fit to levy an Excise Sales Tax of 3 per cent on all energy sales to certain classes of customers, such as residential, commercial, and rural. At the same time the federal government has exempted from this Excise Sales Tax the customers of all goverment-owned electric utilities. There is no justification for this discrimination. The people who buy electric power from the government utilities are the same kind of people as those who buy electric power from the privately-owned utilities. The service is the same general kind of service produced by the same kind of plants and lines, yet because of the ownership about 85 per cent of the citizens of this country pay this excise sales tax whereas the 15 per cent served by the government-owned utilities do not pay it. If these 15 per cent were treated the same as the 85 per cent, the federal government would receive millions of dollars of additional tax money.

In these times when the federal government is desperately trying to increase its tax revenue, it would seem that serious thought and attention should be given to taxing these people who are now tax free and these businesses that are now tax exempt. It would not only remove the unfair and unjust discrimination that now exits but would add to the amount of federal tax money so badly needed now to finance the war.

It is at least interesting to see how the British government raises tax money to pay for its war effort. The following is a quotation from H. C. Lamb, Chief Engineer and Manager of the Manchester Corporation Electric Department, Great Britain: "The publicly-owned utilities bear taxation for state purposes and rating for local government purposes exactly as if in the hands of private enterprise."

In other words, the government-owned electric utilities in England pay what corresponds to our federal income taxes on exactly the same basis as do the privately-owned utilities of that country. I do not know how England treats the taxation of other government-owned corporations, but if the electric utility corporations owned by the government are taxed on the same basis as privately-owned corporations, then it is reasonable to assume that all government-owned business that competes with private business is taxed on the same basis as private business.

Not only will the full taxation of government-owned business bring large sums of additional revenue to the treasury, but it will also prevent the loss of large sums of money to the treasury. If tremendous advantages can be gained through government ownership of business, if such business does not have to pay federal or state taxes, then it is only reasonable to assume that many businesses now privately-owned and paying taxes will sooner or later be taken over by government-owned enterprises, and every time such a change is made, at least under present laws, the federal government will immediately lose the tax money it formerly received from the privately-owned company. The question of taxing these tax free government-owned businesses is not only one of getting additional new money into the treasury, but it is also one of preserving the income that is now paid to the treasury each year.

Taxes are going to be high, not only for the duration of the war but for many years thereafter, to pay the heavy interest charges on the high debt of the war and to retire the debt. Taxes are going to be heavy and burdensome for at least a generation. It seems that those responsible for financing the government must give serious recognition to the taxing of this constantly increasing government-owned business which at the present time pays no federal taxes whatsoever.

Public Service War Bond Sales Nearly Triple Goal

THE "Name the Bomber" War Bond Campaign of the operating companies of Public Service Corporation of New Jersey has resulted in sales through Public Service of War Bonds to the amount of $839,056 issue value—more than $1,000,000 in maturity value.

This amount is more than two and two-thirds times the goal set for the campaign. It will defray the cost of two four-engined bombers and will cover more than two-thirds of the cost of a third bomber.

The campaign's goal for Public Service was originally $300,000. War Bonds to this amount (issue value) were bought in the first ten days of the contest.

Since the campaign ended, additional War Bonds to the amount of approximately $10,000 were bought for cash. This amount is not included in the $839,056 total mentioned above.

Marvin French, Commercial Sales Representative, Trenton, was one of the leaders in the sale of War Bonds to his customers during the "Name the Bomber" campaign.

John E. Manning, State Administrator, New Jersey State Division, War Finance Committee, highly praised Frank C. Pesveyc in a letter to President Edmund W. Wakelee. Mr. Pesveyc was lent by Public Service to Mr. Manning's staff a year ago and is Deputy State Administrator, Retailers' Division, State War Finance Committee. He was also chairman of the Public Service "Name the Bomber" War Bond Campaign.

The Rubber Situation as it Affects Protective Devices for Linemen

By T. R. Claffy

W. H. Salisbury & Co., Chicago, Ill.

Presented before the Accident Prevention Committee, EEI, Chicago, Oct. 8, 1943

THE rubber situation is far better than it was at the time I appeared before this committee almost one year ago. At that time the synthetic rubber program was just getting under way and there existed a serious question as to whether plants could be constructed and put in operation before our national stock of crude rubber was exhausted. But new plants for making synthetic rubber have progressively come into production almost on schedule time and the quantities of these materials allocated to manufacturers have steadily increased, especially during the past few months.

The most vital problem now facing the rubber manufacturing industry is the conversion from crude to synthetic rubber. Stocks of natural rubber have diminished steadily and the day is coming soon when its use will be permitted only in those cases where no one has discovered how to dispense with it in satisfactorily filling particular essential war or civilian needs. The quotas of crude rubber allocated by the War Production Board for use during the months of October, November and December were cut to one-third of the allotments for each of the other quarters of this year. Then after January 1 it is planned that no crude rubber is to be consumed in any case without specific prior approval of the Office of Rubber Director. At that time general purpose synthetics, reclaims and scrap rubber may be consumed in any amounts required to manufacture goods that are on the permitted list.

It is extremely important that natural rubber be conserved. Many important products cannot be made from anything but crude rubber, either entirely or used as a blend to provide the necessary properties for essential articles. The stocks of crude on hand together with the limited quantities that are expected to arrive from South America are not thought to be sufficient to meet these anticipated requirements.

As before stated quotas for the last three months have been substantially reduced—two thirds to be exact. Out of this quota it is the manufacturer's obligation first to fill War Orders which require the use of crude rubber, and then any remaining portion may be used for essential civilian needs.

For several months past the trend has been to convert all general mechanical and industrial products either to synthetic, reclaim or scrap. Government procurement agencies have cooperated by writing or re-writing specifications to permit the use of synthetic whenever possible. By these acts manufacturers have been permitted to save enough crude from their quotas to fill orders for their particular type of civilian products providing such articles appear upon the lists for which crude rubber may be consumed as contained in Rubber Order R-1.

Linemen's rubber goods are still listed on Schedule A of Rubber Order R-1. An amendment to this order, which is expected to be issued about November 1, will greatly reduce the items that are now on the permitted list. However, the technical committee of the Rubber Manufacturers Association have recommended that Linemen's Goods stay on this List A and I feel certain that the recommendation will be accepted. Therefore, some crude rubber will undoubtedly continue to be allocated for linemen's Protective appliances. There is still a question, however, whether our reduced quota will be sufficient to supply the requirements of the industry even at this time. Then, after January 1, when no rubber can be consumed without prior specific approval we undoubtedly will be called upon to prove our case before the War Production Board and this will call for the presentation of facts to uphold our contention that the use of crude is necessary for the satisfactory performance of each individual article.

I do not believe that rubber gloves will be affected in any way. The vital importance of gloves is recognized and due to their limited thickness and high dielectric requirement it is very improbable that any reduction from the rubber content of present-day gloves will be ordered. Experiments with synthetics for gloves have not been successful and this fact is known to the authorities. On the same premise, I do not believe that sleeves will be changed.

A very different situation exists with regard to line hose, insulator hoods and blankets. The character of these devices is such that a portion of the rubber content of each compound may be reduced and synthetic substituted without materially affecting the usefulness of the devices. Taking advantage of our experience in processing synthetics we have successfully made line hose and hoods with three quarters rubber and one quarter synthetic. The hose is just a bit heavier and it is not quite as flexible as the standard hose, but it has ample dielectric and we are sure that it will give good service. Some of this new material is out in the field at this time and we will regularly check upon its performance. It may even be found practical to reduce the rubber content by a greater proportion but this will be determined by our further experience. Our experiments with blanket compounds have not been completed up to this moment but the results of laboratory tests indicate that a blend of synthetic with rubber will be satisfactory.

We would much prefer to use fresh crude rubber in all of our protective goods line. Its greater strength is very desirable and its general character is well understood by all who handle it. On the other hand, the shortage of crude rubber and the necessity for its conservation is appreciated by every good citizen and no one should claim the right to use more than is absolutely necessary for safe work. To do so would be inconsistent with patriotic principals. I am sure therefore, that for the time being a slight difference in the convenient handling and perhaps a shorter service life of line hose, insulator hoods and blankets will be accepted by the industry.

Again I assure you that safe and satisfactory protective devices for linemen will continue to be available.

Essential Accident Prevention Measures in the Design and Maintenance of Substations

By H. S. Fitch
West Penn Power Company

Presented before the Electrical Equipment Committee, EEI, Chicago, Oct. 8-19, 1943

The Tabulation of Fatal Accidents Provides a Key to Action

REPRESENTING the Electrical Equipment Committee, I have been asked by Chairman R. T. Henry to review the 121 fatal accidents which occurred in our industry in 1941 and to suggest remedial measures to be studied cooperatively by the Electrical Equipment Committee and the Accident Prevention Committee. As Mr. D. C. Stewart, who has analyzed these fatal accidents by circumstances and causes has said, "The tabulation provides the key to action. Every safety man, every engineer, every operating man will know how best to tackle the problem in his company." The Electrical Equipment Committee is well constituted in the breadth of experience and coverage of its membership to carry forward its study of the problems as it relates to the substations of the whole industry.

However, that we continue to have accidents is a challenge to our ability as utility executives and engineers for we have the responsibility of station design and for operating and maintenance work. As one reads the details of these 121 accidents,* the unanswerable question keeps arising in one's mind, "Why as late as 1941—and I understand preliminary statistics of 1942 show no improvement—do such things occur?" This question becomes very, very personal when one of our own men is lost. Each of us who has such responsibility and has had such an accident happen under our jurisdiction is plagued with the haunting questions; "What could I have done to prevent this needless waste of life and all the consequences?" and "What can I now do to prevent a recurrence?" Perhaps the 1941 list did not contain the name of one of our men, and we may breathe a sigh of relief that neither did the 1942 list, nor 1943 to date, but any man who will take the time to read the details of these 121 fatal accidents will not congratulate himself or take pride, for he must know deep in his heart that with all the supervision and all the training he has tried to build up, he has been more lucky than wise.

It is not my purpose to recite or review those time-tested methods of accident prevention which have been so well developed by the committee charged with that responsibility nor the accidents in which these established and fundamental rules were broken. The flagrant misuse, or more particularly the non-use, of the simple measures of accident prevention are outstanding in the analysis provided by Mr. Stewart. He declares again and again the need of correct position by workmen and the "must" procedures of wearing rubber gloves, applying protective equipment to wires energized at primary voltages and covering secondaries or grounded objects as completely as is practicable.

Rather it is my job to offer again for our consideration those subjects upon which the Electrical Equipment Committee has worked and which involve protective methods both in design and of supervision, as distinguished from the training of personnel to follow safety instructions and the providing of the best in safety equipment. In this manner I may suggest means for effective action by both committees.

Design Must Consider Mental Lapses

About five years ago, after two accidents on his system, Mr. S. M. Dean of the Detroit Edison Company brought the subject of design of stations from the point of view of accident prevention squarely before our committee in the most crystal-clear statement that has ever been made on this subject. Mr. Dean had come to believe that in many instances there might be a certain relationship in the matter of substation design which might have a bearing on the possibilitiy of accident. He reasoned as follows:

"Any individual who finds himself in a dangerous situation makes a mental 'size-up' of that situation, taking into account various hazards as he sees them. Having made such a 'size-up' in his mind, he goes on about his work depending upon that 'size-up' automatically to warn him if he gets near the danger zone. If the dangerous situation is one that is changing; that is, such as one meets in crossing a busy thoroughfare, the individual must make repeated 'size-ups' to take account of the changed situations. Serious danger to the individual occurs only when, either through some change in the situation which he has not observed or some lapse in his mental 'size-up', the picture in his mind becomes incorrect. Therefore, in the design of substations or any structure or equipment the natural barriers against accidents should be so obvious as to challenge any lapse in mental 'size-ups' which might put the man working in a precarious position, or the design should be such that it is impossible for him to get in such a dangerous position."

Following this thought Dr. Viteles, of the Philadelphia Electric Company, who for years has studied these problems from the psychologist's viewpoint, agreed:

"That regard for safety in substation design can contribute considerably to the elimination of accidents. Much of the progress in accident reduction in the manufacturing industries has come from the provision of safety guards and allied devices which, in many instances, make it virtually impossible for the worker to become involved in an accident. The same principle has, of course, been applied in the system of interlocking switches in the electric industry which, while contributing to the avoidance of error, also helps to reduce accidents. Where safety guards cannot be built into the design, it seems a psychologically sound procedure to provide something in the way of vivid 'barriers' at the key or dangerous points. These need not be actual physical barriers, but may take the form of red paint or some other distinguishing mark applied to points which occupy a prominent position in the operator's 'size-up' of the situation. This is an aspect of the problem which has

* EEI Bulletin, May, 1943, pp. 136-138.

probably been very much neglected because of the tendency to adhere consistently to neutral colors (black, white, gray) in the attempt to satisfy certain 'aesthetic standards' in substation construction. However, whether color or variation in shapes or actual physical barriers be used, the general idea of bringing vividly into attention certain key or dangerous points in the substation seems sound."

In a most excellent article in a recent issue of *Electric Light and Power,* Messrs. J. O. Leslie and D. L. Greene of Gilbert Associates, Inc., discuss some of the contributing causes for accidents as related to this very question of substation design. They state, "Many tragic accidents which have occurred in substations had their inception at the time when unnecessary hazards were built into the stations, because when the hazard and the unsafe act met, another personal injury resulted and was generally recorded as a careless act on the part of the injured. In order to develop a long range 'No Accident Record', all of the contributing factors for accidents which have occurred in the past must be taken into consideration." Then the authors submit a tabulation of substation accidents by indicating the hazards involved, purposely omitting carelessness in the belief that this is controllable through proper training and supervision.

When I review those fatal accidents of Mr. Stewart's report having to do with substations and those cited by Messrs. Leslie and Greene, I find comparatively few accidents due to the use of improper tools or the improper use of tools. I do find over and over again lack of adequate supervision at the time of the accident, insufficient or improper training whereby certain unsafe working practices must have been condoned, and principally in all these varied situations, mental lapses of the victims. The victim, just as Mr. Dean reasoned, made a mental "size-up" of the situation, must have known well that certain equipment was energized, and then by some process of distraction or through impetuousness or desire to improve or finish the job, forgot all about the hazards present. In brief, the lapse of mental "size-up" occurred and he was unrestrained in the carrying out of his misjudgment. A change in the layout to give adequate clearances, application of barriers where congested arrangements prevented such a change in layout, vivid "barriers" at dangerous points, some simple reminder, those considerations alone might have prevented the majority of these fatalities. An alert safety watchman would have saved nearly all of the others.

Now Is the Time to Reconsider Our Designs

The war program has now practically stymied utility construction. It appears today that we shall go through the next few years with what equipment we have. But we do have an opportunity that was not offered to us even in the depression years, to examine critically our plant and its arrangements. We can weed out and correct hazards. We can devise largely by the use of non-critical materials, greater protection to our few remaining older operating and maintenance men for experienced and well-qualified though they may be, this report of 121 fatal accidents shows that it is such men who are generally involved in substation tragedies.

Will your next post-war substation be similar to the last issue of the 1942 models? Now is the time to review with our operating and maintenance men present substation construction with all its varied designs, to determine the best designs we have made and their weaknesses from all points of view. Perhaps we can among us achieve some satisfactory measure of standardization. Economy, utility, conservative use of critical materials, the elimination of gadgets, safety provisions of head and elbow room; all these, coupled with standard operating procedures are the progress we seek.

Fundamental Design Considerations for Cooperative Study

What are some of the fundamental considerations these two committees may study for post-war construction?

1. Simplicity and standardization. Circuits and equipment shall be arranged in as simple and straightforward a manner as possible and so separated that operators and maintenance men may easily visualize the connection of the circuit and their associated equipment and proceed naturally in their work from one step to the next without distraction which produces mental lapses.

2. Well defined working areas. The design must be such that any circuit or piece of equipment may be taken out of service and worked upon without exposing the men to hazardous conditions. If adjacent circuits or live parts cannot be de-energized or where circuit boundaries are not obvious, then suitable permanent and vividly marked barriers shall be installed to prevent men getting out-of-bounds.

3. Provision for similar expansion. The design should be capable of being enlarged upon as the station grows without the need of special unusual features which require the men to watch every step in order not to get into trouble. Hidden, deceptive or imperceptible hazards will be eliminated.

4. Distinguishing characteristics. An unmistakable identity shall be given to individual units. Recent design has and undoubtedly post-war designs will emphasize symmetry, similarity and interchangeability with an absence of outstanding difference between adjacent units. The reports are replete with just such failures of the victim to distinguish the safe place where he had been working from the energized equipment.

Such correction as can be made to the present substations to afford the maximum protection possible, is now in order. As the war progresses and our supply of available materials grows less and less, it appears that a useful recovery of materials and equipment can be made for essential plant expansion by eliminating many duplicate service features we once thought necessary, thereby securing some measure of simplification and greater clearances in our existing substations.

Design Does not Obviate the Need of a Safety Watchman

Apart from these matters of design, the one other outstanding point raised by a study of these accidents is the need for safety watchmen to prevent the men from getting into hazardous locations. In practically every case of unsafe practice or procedure, it appears from the information supplied meagerly in the reports that the foreman in charge of the crew had not only the responsibility of planning the job and getting it done, but also of watching every move that every man in the crew made. Of this we can be sure, a harassed foreman is never a good foreman. Let us consider briefly what our foremen may have to do and may have to think of on an ordinary maintenance job.

First, there is the question of securing permission from the load dispatcher who in turn seeks to guard system service by limiting the equipment outage and who invariably sets an off-peak hour satisfactory to the personal habits of the men and often to the best conditions of working. As a result, evidenced by case after case, the foreman is hurried, for the time

(*Continued on page* 340)

Kilovar Supply on Public Service Electric and Gas Company System

By H. K. Sels

Public Service Electric and Gas Company

Presented before the Electrical Equipment Committee, EEI, Chicago, Oct. 8-9, 1943

THE present scarcity of materials and the necessity for added capacity to handle greatly increased industrial loads in the Public Service Electric and Gas Company system has required continuing investigations of how best to furnish facilities for the supply of kilowatts and kilovars.[1] While the cost in both capital investment and operating expense on any basis of allocating costs[2] between kilovars and kilowatts is much less for kilovar supply than for kilowatt supply, the importance of kilovars is no less than that of kilowatts since the excitation or magnetization of the system is essential to the delivery of power to the customer. Kilovars supplied to the system and the customer are a measure of this excitation.

It is not the purpose of this presentation to deal completely with the economic phases of kilovar supply but to discuss further some of the engineering features of the problem. These features involve studies of the amount and distribution of various forms of kilovar capacity throughout the system and of the installation of certain tap-changing-under-load equipment to maintain bus voltage within certain limits and to make all generator kilovar capacity available to the system at all times. While certain conclusions have been reached under the circumstances of a war emergency, it is felt that they will hold equally well during peacetime when the effort to reduce costs will be quite as desirable.

General Description of System

A description of the Public Service Electric and Gas Company system is necessary as some of the results of the studies presented may hold for this system alone; similar studies would have to be conducted on other systems to reach corresponding conclusions. The layout of this system is not unlike many others but the load, estimated for the 1943 peak as over one-million kw, is probably more concentrated than most being spread over an area of approximately 1400 square miles. This area is roughly

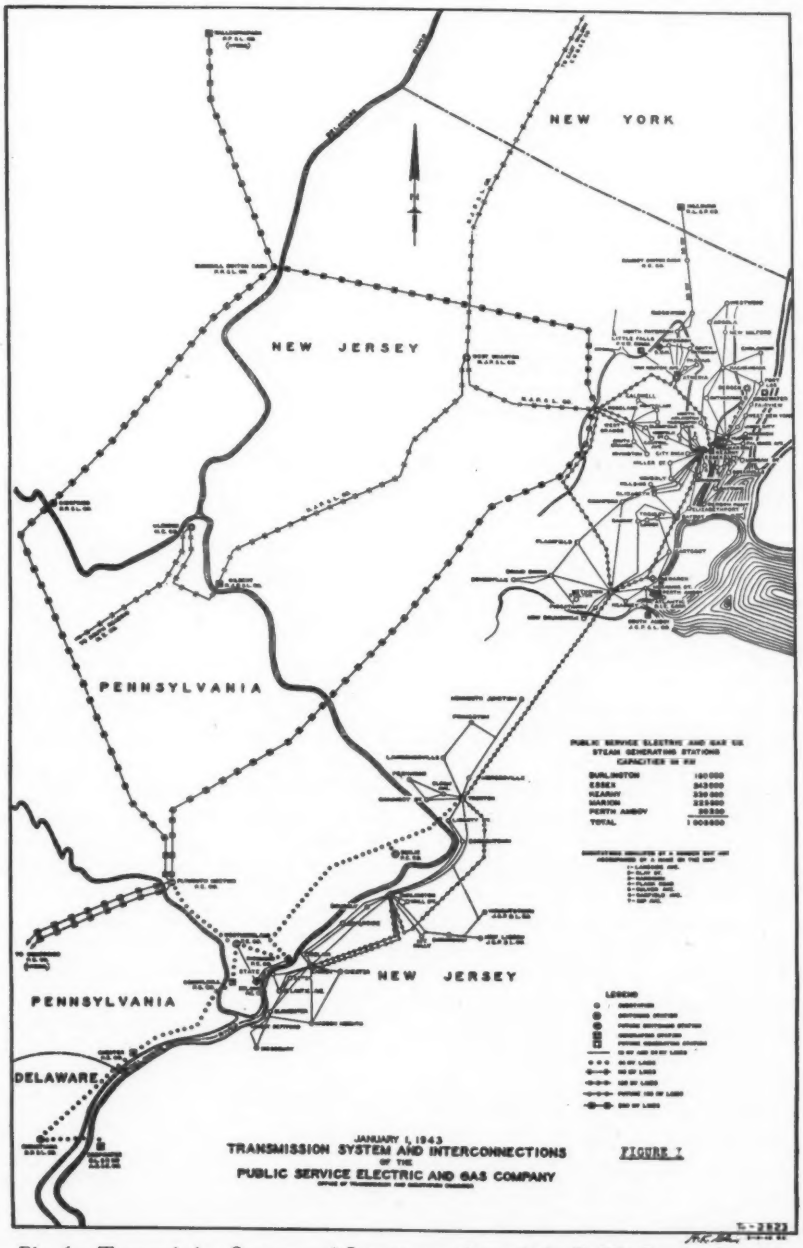

Fig. 1—Transmission System and Interconnections of the Public Service Electric and Gas Co.

[1] "Facilities for the Supply of Kilowatts and Kilovars" by H. K. Sels and T. Seely, A.I.E.E. Transactions Page 249, Vol. 61.

[2] "Kilowatts, Kilovars and System Investments" by J. W. Butler, A.I.E.E. Transactions Page 133, Vol. 62.

TABLE I—SYSTEM REACTIVE CAPACITY

	Kw	Kvars		
Considered as Firm Capacity:				
Generators (Maximum available with summer peak kilowatt demand)		575,000		
Synchronous Condensers or Motors.				
4 Units in Switching Stations		85,000		
17 Units in Substations		106,500		
			766,500	
Frequency Changers				
Marion Generating Station	0	32,000		
	16,000	30,000		
	18,000	28,000	30,000	avg.
Static Capacitors on distribution lines		135,000		
			135,000	
220-Kv transmission system.				
P.S. share of capacitance		18,000		
			18,000	
Total Firm Capacity				949,500
Reactive Capacity considered as part of the load:				
25 Railway M-G sets		29,000		
			29,000	
Bulk Transmission System				
132-Kv Cable, 9 miles		35,000		
132-Kv Open Wire, 250 miles		23,000		
			58,000	
Subtransmission system				
13/26-Kv Cable, 582 miles		29,000		
13/26-Kv Open Wire, 681 miles		1,600		
			30,600	
Total Reactive Capacity in Load				117,600
***Not* Considered as Firm Capacity:**				
Frequency Changer				
Metuchen Switching Station (available at times on application to P. R. R. and P. E.)			20,000	
Total non-firm reactive capacity				20,000

rectangular in shape, and about 100 miles long.

Five generating stations supply the territory through 10 switching stations and 84 substations connected together by 132-kv bulk supply and 13 or 26-kv subtransmission lines. In addition, Roseland Switching Station connects Public Service to the Pennsylvania-New Jersey 220-kv system and the New Jersey Power and Light Company 110-kv system. Several other small interconnections are tied to the various subtransmission networks. Figure I shows diagrammatically the layout of this system.

All generators are controlled under orders of a central load dispatcher. About two-thirds of their capacity is normally hand-regulated. Several large synchronous condensers and frequency changers are located at switching stations and several small synchronous condensers and numerous small motor-generator sets which can be overexcited are located in substations. The larger synchronous condensers and generators provide automatic regulation to some degree. Practically every 4-kv distribution circuit is provided with ± 10 per cent or ± 5 per cent induction or tap changing regulators and many circuits with low power factor load are equipped with one or more banks of static capacitors. There are 706, 4-kv distribution circuits; 143 of these are entirely underground, 28 are more than 50 per cent underground and 87 are less than 50 per cent underground and the remaining 448 circuits are practically all overhead. There are 491 radial distribution circuits, 116 pure multiple network circuits and 99 combination multiple network and radial circuits supplying 85 separate networks.

Kilovar Supply

The present system kilovar capacity is tabulated in Table I as of Oct. 1, 1943. Some of the capacity shown is considered as either a part of the load or non-firm. 949,500-kvar is firm capacity. Much of this has been installed to correct power factor and relieve overloaded or low voltage conditions as they have developed individually. As the static capacitor program developed, the broader picture of kilovar supply has been studied so as to coordinate the entire program. Prompted by the desire to obtain increased kilowatt generator ratings to meet the recent greatly increased industrial loads, the past conception of carrying the major part of the kilovar load on the generators has had to be abandoned in favor of kilovar capacity installed at the load. The problem has therefore developed into the manner in which this could be accomplished with the greatest speed and lowest cost.

Kilovar capacity can be provided by the use of

Extra copper in new generator stator and field windings.
Synchronous condensers.
Oversize synchronous motors on motor-generator sets.
Static capacitors.
Reactive capacity on customers' premises.

The use of reactive capacity in one form or another, and in appropriate locations, can accomplish the following results in addition to the obvious one of carrying reactive load:

Control voltage (raise only, with static capacitor alone).
Reduce kva load between the capacity and the generator.
Reduce system investment.
Reduce system losses due to kilowatts and kilovars.

An analysis has been made of the system costs to determine those elements which are affected by low power factor, starting with the generator as a base and extending to the first load point of the distribution circuit. In the generating station, only the cost of the generator and its switching equipment has been assumed to vary. In switching stations and substations, only transformers and switching equipment have been considered, omitting land, building, masonry compartments and switchboard. In bulk supply lines, rights of way have been omitted, and in subtransmission and distribution circuits rights of way, poles and conduits have been neglected. On this basis the incremental investment per kva which varies with the load power factor has been determined. This investment in the generator once made is probably forever frozen unless it can be used when the kilowatt output of the entire unit is increased. Since added investment in the transmission and substation system is required on the average about every 10 years to carry additional load, it is not needed more than once in every nine years to carry kilovar load alone. In the distribution system, due to the larger number of small units generally having a much lower average loading with respect to capacity, this added investment is probably required as fre-

quently as once in every six years to carry kilovar load exclusively.

The relative net cost of installing kilovar capacity in generators, large synchronous condensers in switching stations, small synchronous condensers or switchable capacitors in substations and non-switchable capacitors on distribution circuits has been determined by evaluating the cost of the equivalent kilovar capacity required, the added system investment component effected by kilovar loading, and the incremental losses in the system and corrective equipment. These computations show that:

1. The static capacitor installations on the distribution circuits are the most economical because of their lower first cost and proximity to the load.
2. Switchable capacitors in substations is the next least expensive method.
3. The small added cost of providing reactive capacity in generators is next least expensive even with the added system investment and no saving in losses.
4. Small synchronous condensers in substations which, while more expensive, save in system investment and losses.
5. Added capacity in the form of large synchronous condensers at principal load centers, which is the most expensive of all due to higher initial cost and small savings in system investment and losses.

Of course these conclusions apply only to the Public Service system or those cases where the breakdown or system costs is nearly the same. Other situations would have to be analyzed similarly to arrive at a proper answer.

Limiting Factors in Kilovar Supply

Having established in a general way from an economic standpoint the most desirable forms of kilovar supply, it is necessary to consider certain limitations that will govern what application may be made of each form. The application of synchronous condensers is limited generally by their higher overall cost which may be partly offset by the automatic regulatory benefits of their operation and voltage stabilizing effects. The limit on the amount of capacitors which may be installed without switching control depends upon the stability of generators with high power factor operation, the kilovar load at light load periods, and the limitations on each distribution feeder.

Studies have been conducted on the stability characteristics of turbine generators[3] which show that the kilowatt loading of generators is a more important factor than their operating power factor. However, with the desire of load schedule engineers to follow the load curve rather closely and keep the lightly loaded units to a minimum, operating power factor is still an important factor when automatic voltage regulators are not used. Furthermore, with older generators and particularly those which have been rated up considerably, operating with weaker than synchronizing field strength may be impossible without pulling out of step. The characteristics of individual machines are so varied that it is difficult to apply generalizations and it becomes necessary to study each system to determine what generator power factors or field strengths must be maintained.

Referring to Figures 6 and 7 of one[3] of the studies mentioned, some idea of the stability of modern generators for various loading and power factor will be obtained. For convenience, Figure 2 has been derived from these curves to show the data more clearly. It is evident that as generators are loaded up, there is less incremental load capacity available to take sudden increases in load. Also, it is evident that those units which are expected to pick up the largest increments of load following an emergency, should be operated at relatively lower lagging power factors or stronger fields. From these data, it may be generalized that for economic advantages:

1. Generators may operate up to unity power factor without automatic voltage regulation with a reasonable ability to carry incremental load if they do not have low short circuit ratio or pull-out point,
2. With adequate automatic voltage regulators so as to maintain normal terminal voltage at all times, following the initial disturbance, the generator may operate underexcited or at leading power factor,
3. Operating spinning reserves may be increased during minimum load conditions so as to obtain more lightly loaded units and provide more incremental load capacity allowing operation with relatively weaker fields, but losses in economy may make this method of operation impracticable for the small gains realized.

The extent to which these generalizations are applied must be based on studies of specific conditions.

Since the unfavorable power factor conditions will most likely occur on generators during light system load periods, it is necessary to determine the minimum kilovar load which will ever occur as the maximum limit of unswitched capacitors. From the annual kilovar load duration curve, the proper proportioning of kilovar capacity between switched capacitors, generator loading and synchronous condensers may be evaluated. Figure 3 shows this load duration curve as estimated for the Public Service Electric and Gas system in 1944 with the allocation of kilovar capacity now existing and tabulated in Table I. In such allocations it is evident that the kilovars available in generators are contingent upon their kilowatt loading and, where interconnections are available, sometimes shortages in kilovar capacity can be made up by purchases of kilowatts. If capacities are available in turbines so that generators may be operated at higher power factors, excessive kilovar capacity may be used to make kilowatt capacity available. How-

[3] "Stability Characteristics of Turbine-Generators" by C. Concordia, S. B. Crary and J. M. Lyons, A.I.E.E. Transactions Page 732, Vol. 57.

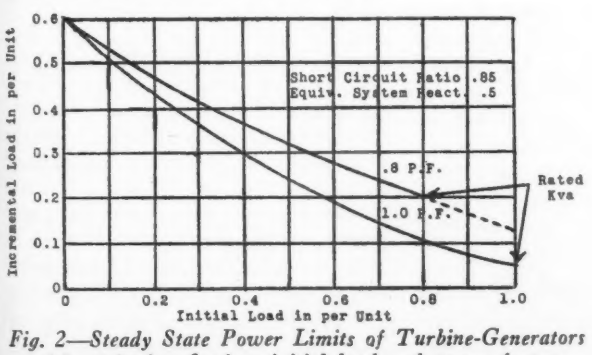

Fig. 2—Steady State Power Limits of Turbine-Generators with excitation fixed at initial load and power factor.

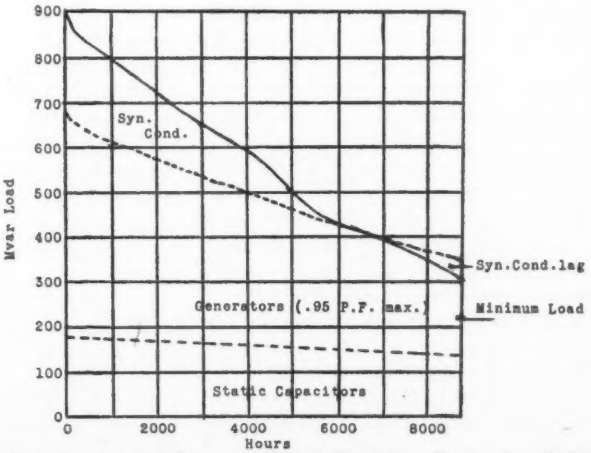

Fig. 3—Annual Megavar Load Duration Curve for 1944

ever, only limited amounts of kilovar load can be transmitted for any distance without excessive voltage drop.

Investigation of the possible distribution feeder locations has shown that capacitor installations up to the minimum kilovar load on the system, 225,000-kvars, can be made. Therefore, 90,000-kvars more of unswitched capacitors may still be connected to this system and still retain lagging power factor on the generator at all times although it will be necessary to operate synchronous condensers underexcited or with lagging kvars to do so.

When peak load conditions require more kilovar capacity than can be furnished with unswitched capacitors, switched capacitors in substations will probably be used as all low-cost synchronous condenser installations in existing buildings have been utilized. So far the unavoidable overbuild spread throughout the system has been such that it has never been economic to correct system power factor to an extent which would result in generators operating above .85-.90 power factor at time of maximum peak; this during off-peak times results in .80-.85 power factor operation. If all elements in a system became fully loaded simultaneously, then generator power factor might economically reach .9 power factor during that time, and some justification of this condition is found with present loads. When generators are rated at .9 power factor, a higher short circuit ratio would be desirable to increase their incremental load capacity.

Static Capacitors

Since the major justification of capacitor installations lies with the system requirements, some expansion of the natural field of the capacitor is warranted in the realization of minor distribution economies. Under present long delivery schedules for equipment, the capacitor may well be employed as a temporary expedient for overload conditions without extreme penalty because of its low installation cost and high mobility. Furthermore, long-range economy of the capacitor versus other forms of plant addition may now indicate the capacitor as the proper solution because of the temporary nature of certain loads now being taken on and the high voltage value which is realized in the capacitor.

The experience gained from some 400,000-kva-years of shunt capacitor operation may be of interest to those who are as yet undecided as to the desirable characteristics of capacitors. On the Public Service system, capacitors are installed in 180-kva wye-connected three-phase banks, using 12 individual 15-kva units for each installation. Indicating type cutouts are used on phase connections for supervisory purposes, and the capacitor cases are solidly grounded by connection to either driven ground or multi-grounded common neutral.

Until early in 1942, at which time the programmed conversion of the distribution system from uni-grounded neutral to multi-grounded common neutral was instituted, the capacitor bank neutral point was solidly connected to the circuit neutral. As extension of multi-grounded operation progressed, instances of telephone interference were experienced, which were corrected by installation of neutral reactors on 12 capacitor banks. The need for similar inductive coordination measures arose in additional instances, and rather than extend the use of reactors, it was decided to isolate the capacitor bank neutral from circuit neutral where required by harmonic interference. At present, approximately one-third of the banks have floating neutral, without any evident impairment of service during the two lightning seasons since the institution of the practice.

The type of lightning protection employed depends upon whether the supply circuit has uni-grounded or multi-grounded neutral, and whether, in the latter case, the bank neutral is fixed or floats. On uni-grounded neutral circuits, with capacitor bank neutral fixed, conventional phase arresters are installed. On multi-grounded neutral circuits, with capacitor bank neutral fixed, no arresters are used. On multi-grounded neutral circuits, with capacitor bank neutral floating, no phase arresters are employed but a 5000-volt neutral gap is installed between the bank neutral point and the multi-grounded common-neutral conductor.

The operating record of all capacitor units on the Public Service system is regarded as highly satisfactory. With a total of approximately 9000 15-kva units in service, the failure rate for the last 12 months has been 0.3 per cent, of which one-half were electrical failures in operation and one-half were the result of manufacturing defects, mechanical injury, and other external causes. No case of harmonic resonance has as yet been encountered.

Tap Changing Equipment

Following the normal practice of hand field regulation on generators and carrying as much of the kilovar load on the generators as is possible or economical may lead to excessive voltage gradients in the transmission and distribution system. Also faced with the necessity of maintaining certain voltage limits on switching station, substation and high tension customer buses and holding within a ± 3 per cent voltage variation on regulated primary and secondary customers' services it becomes necessary to install either synchronous condensers in substations or tap-changing-under-load equipment on certain step-up and step-down transformers even though the generator buses are regulated higher during heavy load periods and lower at light loads. In some cases tap changing equipment is cheaper if sufficient kilovar capacity is available and the kilovar load can be transmitted without incurring too much loss.

In fact, tap changing equipment is necessary to some extent to avoid building up excess reserves of kilovar capacity. Network analyzer load flow studies have demonstrated that unavailable kilovar capacity may be as much as 10 per cent of the installed capacity and the installation of tap changers in transformers between generating stations can frequently make much of this capacity available and still meet given bus voltage limitations. Therefore this type of equipment may avoid the installation of kilovar capacity by keeping the unavailable kilovar capacity to a minimum and maintaining customers' service voltages within given limits when sufficient kilovar capacity is available in generators or condensers at other locations. It is, therefore, possible to install kilovar capacity at the most advantageous location which will release other capacity for the benefit of other locations. The installation of a ± 5 per cent tap changing transformer at Essex Generating Station has released approximately 25,000-kilovars of excess station capacity to the system and at the same time has improved the 132-kv system voltage conditions.

Analysis of Loads

It is evident from the system load data that the lower day load power factor requires a portion of the kilowatt capacity over the December evening peak to handle the heavy kilovar day load. Also the December peak kilowatt load does not greatly exceed the following summer kilowatt load. Therefore in any given calendar year when the load is steadily growing the required installed capacity

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Some Observations on Postwar Distribution Problems

By C. E. Greenwood

Commercial Director, Edison Electric Institute

Presented before a meeting of the Southeastern Electric Exchange, Atlanta, Ga., Oct. 28, 1943

UPPERMOST in the minds of American citizens is the winning of the present global war. This does not preclude the diversion of many minds to a study of plans for winning the peace, because never has there been such an era of destruction of human and material values as in these war years and the reconstruction period will be long and difficult. Never has American industry met a challenge such as fulfilling the almost fantastic production demands for war materials. Factories were completely revamped and capacities increased many-fold.

As we of the utility industry attempt to chart a course by which we can formulate plans for postwar load building, we must study the impact of this industrial war effort on the markets for electrical service and the products of utilization. I will point out a few of the more important situations which appear to me to bear directly on peacetime distribution problems that concern the residential classification of utility services.

First, in formulating the broad base on which we build our postwar plans and hopes, Government's present investment in business is of chief concern. The stake of Government in war plants built, or expansion to old ones, is close to $20,000,000,000. Of this $20,000,000,000, 78 per cent or approximately $15,500,000 represents the contribution of the United States Treasury. Only about $4,500,000 were supplied privately. It is also pertinent that 100 of the large corporations were awarded 86 per cent in value of contracts in 1940. Efforts to protect smaller business reduced this percentage to 70 per cent of the basic contracts in 1942, but small business has been sharing mostly in subcontracts. What is going to be the picture when production for war is stopped? How will private business be able to finance the present investment of Government in it, assuming the Administration might be inclined to dispose of these plants? Answers to these questions must be found if the system we call Private Enterprise is to endure. Let us start with the assumption that business will not be in competition with Government, and the millions wanting employment will get jobs.

Secondly, we hear discussion about what may be done along manufacturing lines, with these spare capacities for manufacturing durable goods of both privately-owned and publicly-controlled enterprises. The re-conversion problem will be stupendous. Therefore in the study of distribution plans the length of this re-conversion period and the new product timing are of major concern. War Production Board officials have suggested freezing of 1942 models of consumer products for a stated period following the close of the war. The automobile industry has already been approached, and an executive of a prominent electric refrigerator manufacturer has stated that their first postwar model will be their 1942 models. Others will follow suit. However, if that 1942 model refrigerator, range or what-not is on the postwar market, will you invest in one if the tools for newer and more drastically improved designs are in the making? As Vice-President Wallace stated before a recent Congressional Committee hearing: "When the veil of secrecy imposed by war is lifted, our people will stand amazed at the array of inventions."

Speculation running rampant among us can predict many of these new inventions and designs in the household appliance list—plastic refrigerators equipped with transparent lighted panels, electronic tubes for killing bacteria, and quick-freeze compartments; ranges with glass ovens and built-in cooking appliances; electric cooking by induction using regular 60-cycle energy which is three times faster than regular heating units; zephyr weight vacuum cleaners with more power and changed design for easier operation; the completely automatic laundry machine that works; bent tubes for more artistic fluorescent lighting applications in homes; heating, cooling and dust-consuming units that perch on your window-sill; staticless radio, perhaps with television or perhaps with stockticker-type newspaper attachment. One manufacturer is currently advertising his postwar electri-steam iron that really looks like an iron.

There can be slight doubt that the electrical industry will have its share of these new products. There will be newcomers in the manufacturer group, names prominent perhaps in the industrial field but not previously emblazoned on any item of electric equipment. These producers have their own retail outlets established in other lines. Will they use them exclusively for distributing electrical items? There is evidence that they will. One of these industrials has publicized in the press its new Manager of the "Car and Home Merchandise Department." Another company handling similar lines, and with national distribution, is taking on electrical lines. Such policy will result in large expansion of electrical outlets.

Incidentally, do not be misled by the rumors of all the new manufacturer participation in the electric appliance market. There are those that have investigated and have changed their earlier plans. Others are definitely committed. In addition to the newcomers, there will be familiar manufacturers' names of high reputation on expanded lines of appliances. In fact, several complete lines will be offered in the electric household field.

Now a third point of interest is speculation on future market situations. Changes have come about in that pre-war market in which you promoted equipment. It appears that we will start our promotional plowing in richer soil because in just the period between January 1, 1940, and July, 1941, there were 4,500,000 families that moved into income levels over $1,000 per year and 6,000,000 moved over the $2,000 line into upper levels. These families want better living; they can be buyers of electric equipment. Money is coming to them now when there are less consumers'

goods on which to spend it. Granted that we find gains in sales of such items as furs, liquors and jewelry of from 40 to 75 per cent, we are told by the U. S. Department of Commerce that 72 per cent of the middle income wage group is definitely accumulating a surplus for postwar buying.

One other notable change in our market concerns the plight of the white-collar worker. Over the past seven years salaries in this class have increased but 15 per cent while wages of labor are up 49 per cent. At the same time the tax power has been applied to the white-collar salary so that the loose money this man—you and I—have for spending has shrunk almost a third. The spending margin of the wage earner has increased approximately 92 per cent.

These sharp changes in the national economic structure give us food for thought. Fortunately the salaried group has enjoyed the benefits of electrical living in normal years. They have made investments in equipment in pre-war days, but in this group will be a potential market for replacements.

The concern of our industry will be with the employment record together with the status of local financing facilities and terms that may prevail. Assuming a fairly high level of employment to continue following the Armistice—and industrialists must keep millions at work in the Government plants which they may acquire, and in their own factories, if they are to protect Private Enterprise —there will be waiting a large new class of buyers for electric equipment.

Now it may sound strange to ask where these people will live, but this is a fourth point to which I would direct attention. Someone has said that advertising to markets is like talking to a parade, that is, new generations are coming along and old messages are ever new. The war has injected a new element into the market picture, that is, migration of population. In some sections of the country it is startling. For example, the populations of the cities of San Diego, Los Angeles, San Francisco, Seattle and Tacoma were shown in the 1940 Census as approximately 5,777,000. In April of this year the increase had been over 900,000 or 15 per cent. The increase in industrial workers only between 1940-43 in these cities was 208 per cent. In aircraft the increase in labor was 1204 per cent and in shipbuilding 2868 per cent. Other sections of the country show startling concentrations.

What percentage of labor will remigrate? We cannot but believe that utility services in war production will face great readjustments in the residential classification. It is suggested that you might include the study of migration of population in your postwar thinking with special reference to its effect on residence consumption.

And what about expansion through building? It is expected that there will be a rollicking market for new homes in peacetime. Government agencies estimate the building boom at 1,000,000 a year; but the more conservative estimate of the Department of Commerce at 600,000 is more likely to prevail.

Incidentally one of the speculations of the future in building is the popularity of the pre-fabricated type among these homes. Although an estimated 200 companies are in this business today, the capacity approaches but 125,000. Do not interpret pre-fabrication as the demountable type only. Of greater importance is the standardizing of designs, dimensions, and pre-fabrication of parts to speed construction on the home site which results in much more house for the money.

In the homes planned in the $5,000 class and under, electrical equipment is most suitable. A prominent aircraft manufacturer is flirting with the idea of building a complete electric kitchen unit for one manufacturer of such homes. Goodyear, the tire and rubber manufacturer, has demonstrated an accordion house of plywood plastic intended for a permanent home. It can be folded for shipment. Opportunity surely lies ahead for closer coordination between the utility and the construction industries.

The point of interest to this meeting in pre-fabricated homes is that electrification of this type injects a new class of dealer into the peacetime electrical field. The potentialities of local building supply dealers merits your earnest consideration. An executive that can speak with authority in the construction industry predicts that five years after the war, 50 per cent of the homes built will be of the pre-fabricated type. Here again is a new influence in the process of distribution.

We in the utility industry have observed a sharp gain in the prestige of household electric servants in these war months. As homes have been broken up when sons and daughters joined the armed forces, and other daughters and many mothers went to work in factories or performed war services, a new value has been placed on electrical servants for convenience and time-saving in housekeeping under trying circumstances. In Britain more and more dependence has been placed on electrical equipment. Damaged equipment in blitzed areas has been salvaged to keep similar servants operating elsewhere.

So in America today, women know and use electrical equipment more than ever before. Housemaids are in the class of "critical materials." The lack of such labor-savers when out of whack has been shown as an important factor in women absenteeism in war production plants. In this regard the washing machine and iron are tops. Incidentally the washing machine is tops in Britain too, because, according to a recent cable to the *Wall Street Journal,* "the Dean of Canterbury, having had personal wartime experience with the drudgery of housework, has been telling women in 200 towns of the virtues of American washing machines."

Appliance maintenance in wartime is of such importance that agencies in WPB, OCR and OWU have been working toward the objectives of the release of essential metals to the manufacturers for an adequate supply of repair parts for the real labor-saving appliances, and even some replacement stocks are being planned for the coming year.

It is encouraging to find a sympathetic response by OPA for price adjustments which will enable utilities to undertake servicing without substantial losses as shown in past months, should there be a breakdown of other maintenance sources. It is of further interest that of the 194 utility companies answering a recent questionnaire 175 are now engaged in appliance repair work and these companies expect to continue this policy in peacetime.

The sympathetic response of these Government agencies to civilian needs expressed in assistance to manufacturers, utilities and dealers, is a helpful background to the National Appliance Conservation Program of Edison Electric Institute which is in process of development and soon to be officially announced.

The dealers today are making a struggle for survival and need all utility assistance possible to give them, consistent with its protection of service responsibility to the electrical consumers. As Mr. Preston Arkwright, President of Georgia Power Company, an acknowledged leader in forward thinking, has said,

"Our customers, when all is said and done, are the only real asset we have." And we add, it is the utility's responsibility to protect it.

Now my fifth observation on postwar distribution concerns retail outlets to serve these future markets under discussion. There is evidence that former practices may be modified in the light of competitive developments in the manufacturer branch of the industry. At the beginning of the war there were an estimated 50,000 dealers in electric equipment of all classes, about 26,000 of them doing a business of more than $5,000 annually; the others less than that amount.

The holocaust of Pearl Harbor started a new era in the electric appliance industry. Manufacturer production schedules for most equipment slowed down and finally ceased as the demand for war materials became immediately urgent and plants were converted for all-out war effort. Limited items were still produced in the essential appliance list for industrial housing only. Wholesaler and dealer stocks of electrical equipment dwindled rapidly when consumers realized they were not to be able to buy again for the duration and a joyous seller's market was created.

Out of 194 utility companies previously referred to in a survey, 108 companies estimated the postwar mortality of electric dealers in the territory they served—assuming the war to continue through 1945—at 50 to 100 per cent. Sixteen companies indicated 100 per cent and nine companies expected no losses. Only 49 companies submitted estimates below 50 per cent.

Right here it is pertinent to ask a $64 question; namely, what part the electric utilities may take in postwar retail appliance distribution. I will be bold enough to make some comments on this controversial subject. Over a long term of years it has been my privilege to study trade relations matters and participate in scores of conferences with representatives of other trades concerned with the utility in the development of the electrical business. Let me start with the general statement that policies are made by management, and rightly so, in accordance with the demands of local situations, and for several years there has been harmony between the utilities and the dealers under both direct and indirect merchandising policies. The responsibility for loadbuilding must always remain with the utilities. The method to be employed in Victory days will await an appraisal of local conditions as they may develop.

Recent issues of certain trade press magazines have indicated a desire to be helpful as mentors on dealer thinking, and in view of the publicity given to the subject, Edison Electric Institute conducted a brief survey to test utility thinking. Out of 161 utility companies answering the questionnaire on speculative postwar merchandising policy, 131 companies state that in the light of present developments they expect to merchandise certain classes of equipment after the war.

I cannot too strongly emphasize that these statements are qualified with unanimous opinion that selling will be planned to minimize competition and to fully cooperate with the dealers on a live-and-let-live basis. Through selling on constructive merchandising principles the electrical equipment business in a community can be stabilized.

A few manufacturers have also been helpful with opinions on what they believe to be sound utility-dealer relationships. Typical statements are as follows: "It is our considered opinion that the dealer operating without the promotion and sales activities of the utility does not score as great a volume of business as is the case where the utility aggressively merchandises, selling direct to the consumer."

Another comments: "It has been my personal experience, over the past 20 years, that wherever the utility company was doing a very ethical merchandising job, more appliances were always sold and dealers were happier and far more prosperous than otherwise."

These opinions are not included in this discussion as a brief for any merchandising policy. The fact is that one of the manufacturers quoted has his own dealer set-up nationally. Also please bear in mind that but a small fraction of annual appliance volume has been sold through utilities in the past five years.

Following my very recent discussions with some representatives of other trades, I think they are more alarmed with the merchandising of competitive chain groups and cooperatives than with the electric utilities. However, there appears to be no reason for concern about this element of customer service, nor for further discussion while we are winning the war.

For those utilities that may join with the dealers in cooperative merchandising practices in postwar years I would suggest they take from their files a Statement of Merchandising Procedure prepared jointly a few years since by utility executives and leading representatives of the trade. If these Principles of operation are somewhat dusty, it is only because the utilities so readily charted new merchandising plans that brought the dealer more actively into cooperation in selling, and there was no further requirement for that constant reminder from the trade of unfair competition. Hang this statement on the wall again. In substance here is how it reads:

It is recommended that electric utility companies take the initiative in bringing about conferences with dealers in their localities to the end that the following or other mutually acceptable procedure be recognized, adopted, and put into use for the purpose of stimulating the sale of suitable electric appliances and promoting the use of electric service in a way that will be mutually advantageous to the consuming public, the utility, the appliance manufacturer and all merchandising outlets.

1. The distribution of electric appliances should be on the basis of fair and open competition in the interest of the consuming public, the utility, the appliance manufacturer and all merchandising outlets.

2. No appliance or merchandise not directly related to the use of electricity should be sold by electric utilities.

3. In all merchandising activities the retail price of all electric appliances that have received reasonable customer acceptance should be consistent with present-day merchandising practices.

4. There should be no premiums given nor trade-in allowances made in connection with the sale of any such appliance.

5. The presenting to the public of those electric appliances not having received reasonable customer acceptance should be considered as promotional activities and not as merchandising activities.

6. Coordinated advertising of approved appliances should be developed by electric utility companies and local dealers, and the electric company should give all reasonable assistance to the dealer in advertising, displays, and sales assistance.

7. The deferred payment feature

of merchandising activities should be on an economically sound basis."

This considered pronouncement helped stabilize merchandising procedures over the past decade and might well serve again in the Victory period in continuing friendly relationship with the local trades and the public.

The retailer, as the vital link in distribution, should be the concern of the manufacturer and wholesaler alike with the utility. It is significant that at a recent meeting of the Postwar Planning Committee of the National Electrical Wholesalers Association, the Research Manager of a leading national magazine urged the importance of a selective market and carefully chosen dealers rather than indiscriminate distribution. A Professor of Marketing, speaking on the same program, pointed to the vanishing group of "smaller" dealers. Two years more of the war emergency will serve as an acid test of the efficiency and credit stability of the dealer group. Those who weather the gale will merit strongest support of the utilities in the reconstruction period as well as at present. There can be no question of the cooperative help of the wholesalers in solving the problem of dealer survival.

Although the problem of appliance maintenance involving relationship with both dealer and public is the leading one for solution in the process of serving residential consumers at this time, there are rumors that critical materials may be released for building a given volume of replacement equipment—electric refrigerators, ranges, irons and washing machines. As the peak of war production is passed, can we not expect there may be a general pick-up in the production of former models of household electric equipment in advance of the Victory period. This is one rift in a clouded picture for which we see hope of better dealer days.

Present trends which will affect postwar distribution—Government in business; the re-conversion period; new manufacturers and advance model products; changing income levels and shiftings in population; the mortality of many present dealers and the coming of members of the chain family; and the redefining of utility dealer cooperation—all of these will have a direct bearing on residential loadbuilding in the Victory period.

These subjects require periodic evaluation in the light of month to month developments. The thinking of all industry is in a state of flux, but who among us will doubt but that with unified commercial effort the aspirations of the utility and associated industry groups will be fulfilled.

Kilovar Supply on Public Service System

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is determined when maintenance schedules are the heaviest and failures and system disturbances are most likely to occur, that is during the summer period.

Every additional kilowatt of industrial load (day load) has associated with it approximately one kilovar of reactive load; this reactive load must be carried just as surely as the power load. Therefore, every kilowatt of turbine capacity added to the system must have added with it one kilovar of reactive capacity for individual load or about one-half kilovar for residential load. Since reactive loads cannot be economically transmitted as far as power loads this means that reactive capacity must be selected and located more carefully than power capacity, generally closer to the load.

While industrial customers should be encouraged to use high power factor equipment, the problem of high power factor operation and hence more unstable generator operation must be avoided. Operating engineers should be free to choose the factors that make for the best balance of kilovar supply between generators and customers. However, if standardization of kilovar supply is to be obtained, it will be necessary to adopt policies which will produce somewhat the same load characteristics.

Consideration has been given to kilowatt and kilovar load reduction by reducing system voltage but since system and customer voltage regulation is obtained by feeder regulators installed in substations the system voltage reduction would not take effect until the regulators had locked out. Since system stability is also rapidly decreased with system voltage and tests have shown that a reduction in voltage reduces the load almost proportionately, this scheme of load reduction is not considered feasible or desirable. Hence the problem reduces to one of providing adequate facilities. If, for any reason these facilities are not sufficient, load must be dropped or customers must be called upon for load reduction.

Summary

It is not the intention of the author to restate the conclusions which have been tabulated throughout the article but to close by focusing attention on four points:

1. The data which form the basis of the studies apply only to the Public Service system and should not form the basis of a generalization but may be accepted as a method of analysis.

2. Reactive capacity in one form or another, particularly capacitors, can quickly make available additional kilowatt capacity and by proper location postpone the installation of additional transmission and distribution facilities.

3. Extensive application of kilovar supply close to the load is not likely to permit standardizing on .9 power factor generators with low short circuit ratio.

4. Uniform policies throughout the industry would be desirable to promote the use of higher power factor equipment but must avoid its improper use by customers.

Except for Aluminum, Electricity Is Not Mentioned in Study of Migration of Industry

CHAPTER 4 of the recently issued study on "Industrial Location and National Resources" of the National Resources Planning Board deals with the "Shifts of Manufacturing Industries." It analyses the causes and results of the migration of all groups of industries employing more than 10,000 wage earners. Except for the one statement that: "Very probably it was cheap electricity in Tennessee and power from cheap fuel in western Pennsylvania that resulted in the expansion of the aluminum industry in those two States. Once more the only outward shift of consequence was from New York," the report makes no mention of electric power.

The summary says:

"The most common reason (for locational shifts of industries) was market considerations; these accounted for 44% of the industries and a nearly equal percent of the wage jobs. . . . Labor cost differentials were recorded as the predominant reason for about one-third of the industries and 38% of the wage jobs. . . . As one would expect in an industrially mature economy, the factor of raw materials accounted for the smallest share of the locational shifts, about one-quarter of the industries and one-fifth of the wage jobs."

Electronics and Post-War Industry

By A. C. Montieth

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PROPERLY applied, electronics can be one of the biggest post-war possibilities in industry.

But as with all such scientific developments, the "pay-off" from potential markets follows in the footsteps of expert engineering application of the new technique. So despite the lure of fascinating gadgetry only uses that pay-their-own-way will live long enough to show a profit. The strength and earning power of electronics in industry will be in 1) performing a useful task that is impossible without it; or 2) doing a job better or cheaper than other methods will do it. With these thoughts in mind and an eye to the future, it is interesting to see what industry is already doing with electronics, what lies ahead and what effect may be expected on the businesses of the world. How electronics has helped some of the metal industries is a timely and significant story.

The production of aluminum and magnesium of which we have heard so much, requires every bit as much as the ore from the earth, large quantities of electric current. This power must be in the form of direct current and not as alternating curent, in which form it is now almost usually initially manufactured. To effect the change from alternating current to direct current requires some rectifying device. This can be and indeed was until only a few years ago, rotating machines, called motor-generator sets, which do not come under the heading of electronics. Or it can be done by mercury-arc rectifiers, without moving parts and in which the rectification takes place by electronic means.

At the beginning of 1940, all industries such as electro-chemical, transportation, central station, steel, etc., had 500,000 kw rectifiers in operation or on order covering a period of 15 years. In three years' time, five times this or 2,500,000 kw of rectifiers have been purchased in this country and two times or 1,000,000 kw have been purchased in Canada. All of this equipment will be in operation within the next two or three months.

Most of this new electronic-rectifier equipment is of the Ignitron type conceived in Westinghouse Research Laboratories and developed into a commercial design by Westinghouse engineers. In the Ignitron type of rectifier the losses are approximately half of the former types with an outstanding improvement in reliability which is the principal reason for its use in such large numbers instead of the motor-generator or non-electric rectifier. The use of the Ignitron in the aluminum and magnesium programs saved the installation of a 60,000 kw station worth 80-100 dollars per kw because of improved efficiency or lower losses.

There has been a total of approximately $120,000,000 worth of business done in this field in the last five years, $70,000,000 of which has been done by Westinghouse.

Looking to the future in this type of business we can see that the trend is going to swing from electro-chemical industries to general industrial customers. Also, where we have been selling rectifiers for 60,000-ampere aluminum and magnesium producing unit, our future business will be in smaller units of a thousand amperes or so, or smaller rectifiers for a wide variety of industries. Ignitron rectifier equipment is now available for the complete range of d-c power requirements of all applications from 45 kw up to the large electro-chemical type of installations with over 200,000 kw installed in one plant. The standard equipment is designed for the practical range of factory voltages ranging from 125 to 900 volts. The idea of factory-built and assembled apparatus has been extended to this type of equipment, units being available requiring practically no installation work. In the Ignitron rectifier we have electronics at work on a big scale.

Some industrial companies that require large quantities of direct current have been hesitant to apply rectifiers, preferring to continue the installations of motor-generator sets. We see very definite evidence that this hesitancy is fast disappearing. Fourteen thousand kw of Ignitron-type rectifiers are being installed at the present time in a western steel plant to supply power for driving auxiliary machines in the steel mill. Also, an Ignitron rectifier is supplying the power to the main-roll motors in another western steel mill.

The general idea of using rectifiers has been extended to applications where frequency conversion from the more common 60 cycle power to the less common 25 cycle power is necessary in industry. The principles developed from this type of application will be very useful in making an engineering decision on how best to handle some of the problems in the much discussed direct-current transmission of electric power. Studies indicate that long-distance transmission of power from large hydro-electric developments offers opportunity for direct-current transmission. Its future progress is still dependent upon the development of economical and practical tubes for converting the more general alternating current to direct current for transmission from the hydro-electric site over the line to the receiving end where it is reconverted to alternating current.

Developments for other war needs are contributing to electronic tube improvements that will, no doubt, be applicable for this purpose but in the final analysis the decision regarding the use of direct-current transmission must be based largely on economic considerations. High-voltage cable circuits may be the first to utilize direct-current transmission. There is still, therefore, development work before a large installation of direct-current transmission can be made but the electrical manufacturers are now working on equipments that are solving some of the problems involved.

Another market for this type of equipment that was just beginning to develop prior to the war is the use of rectifiers in metropolitan areas where the old Edison or direct-current system of power distribution in big cities, such as New York, is being replaced by the low- voltage alternating-current network system. The rectifier equipment will be used in this field where there is so much expensive equipment in an office building that it is economical for the power company to supply a limited amount of direct current for this equipment. The rectifier

is ideally suited for this application because it can be made push button operated, makes almost no noise, and has no moving parts.

We have seen good acceptance for the rectifying equipment in mining service and its use will be more extensive in this industry.

Broadly speaking, the rectifier is going to be a real competitor of rotating conversion devices wherever direct current is needed in industry. The rectifier is now a very reliable device and has the advantage of no rotating parts which minimize maintenance.

Carrier Current

Many years before WPB was ever dreamed of electric power engineers dreamed up a way to make transmission wires do the double job of carrying information as well as electric power, thereby saving the copper in a separate pair of telephone wires. This scheme is called carrier-current and has become quite popular in the power-transmission field because of the large savings that can be made in system capacity through its use.

The operation of protective relays with information provided by carrier-current in combination with high-speed circuit breakers makes it possible to remove short circuits from systems in times as short as 1/20 of a second. This not only releases system capacity but eliminates burning of the equipment and undesirable system disturbances. To get some idea of what 1/20 of a second means, hold a coin ½-inch from the desk and drop it. Let us consider an example of a saving of system investment through the use of carrier-current relaying. A certain project required the transmission of a large block of alternating-current power for a distance of approximately 250 miles. The high-tension transmission lines, two of which were installed, each cost approximately $6,000,000. These two lines equipped with ordinary mechanical type relays, had a certain current-carrying capacity. Through the installation of carrier-current relaying the capacity of these lines was increased approximately 50 per cent.

In other words, the equivalent of a third line was obtained through the use of carrier-current relaying. A saving of $6,000,000 in investment was made as a result of a small additional investment of $50,000 in carrier-current and associated apparatus.

In this discussion carrier-current in connection with relaying has been used as an example but we should not overlook the fact that carrier-current has far greater possibilities in a power system than for relaying alone. We find its use expanding into power-system control, telephone communications, long distance transmission of metering and telling information and the like. On account of the possible savings in critical materials, WPB is considering releasing for purchase a number of carrier-current projects.

In terms of other branches of the field of electronics, carrier current is a relatively small item. On the other hand, it probably will be a steady type of business. In the past five years there has been approximately $3,500,000 of business done in this field.

Precipitron

Another application of electronics is that of the dust and pollen removal from ventilating air. This is accomplished by an electronic device known as an electrostatic dust precipitator and called by my Company, the Precipitron.

The use of electricity in the smoke precipitation problem is not new. The Cotrell process has been in use for some years. The Precipitron, however, allows a more compact design so that it is economically and physically possible to use the device in ventilating ducts, in buildings, industrial plants, homes, and the like. In the early stages of this development a market analysis indicated a promising possible field for a home-size air cleaning unit. It is of interest that, as matters have turned out on account of the war, very few home units have been built.

Instead, the Precipitron has been extensively used in the cleaning of air in the large, expensive and important motor rooms in steel mills. It has also been extensively used to clean the air in precision aircraft manufacture, as well as in film-processing rooms and the like. Its applications are expanding. We find great interest in its use for taking oil mist out of the air in machine shops. This is not only of importance in connection with the efficiency of lighting but also in the maintenance of shops. The Precipitron on a trial installation collected four gallons of oil in 24 hours from one machine. Although this is possibly an extreme case, nevertheless, it indicates the amount of oil that could have been deposited on the walls, windows and fixtures which not only means an oil saving but a simpler housecleaning job in the shop.

Let us look at the smoke precipitation problem for a moment. To solve the tough problem of smoke abatement from industrial and power plants, Westinghouse in cooperation with Prat-Daniel Company have been working on a way to combine the electrical Precipitron with the mechanical type of cyclone precipitator. This scheme shows promise where large volumes of solid material have to be handled, the mechanical precipitator getting the heavy particles and the electrical precipitator taking off the lighter particles.

The Precipitron is, relatively speaking, a newcomer in the electronic field. It was conceived some 10 years ago in the Westinghouse Research laboratories, but has had extensive commercial use only in the last three or four years. Approximately $5,000,000 of business has been done in this time, most of which has been in industrial plants. The use of this device in industrial plants is bound to expand when restrictive orders on critical materials are raised.

There are several yet untapped uses for it in other industries, and to each when applied, it will bring the many benefits that accrue from operating in absolutely clean air. Only a bare beginning has been made in cotton mills which is still a very promising field for the device and there is no question that the home market will rapidly develop for this device after the war.

Control

A large number of applications of electronic devices have been made in the field of electric machine and industrial process control. When we talk about control we mean all types of devices, such as voltage regulators, speed and process controllers, welding timers, motor controllers, and the like.

In the production of planes, ships and all mechanical type devices, production has increased manyfold through the use of electric welding. Electric welding has played a leading part in the war program. The Ignitron has also been one of the keys to resistance-type electric welding as it lends itself admirably to a very precise type of control for the higher currents that must be handled in modern welding practice. A large variety of timers for accurately controlling the welding cycle have been built and electronics has made possible much of the fine control that has been used in this welding field. In the past five years there has been a total market of approxi-

mately $8,000,000 for the electronic welding-control equipment.

Another fine example of how electronics is contributing to the speeding of production is on machine tools where the speeds of motors are accurately adjusted over a wide range. An electronic device called the Mot-O-Trol is another form of electronic device that converts alternating current to direct current directly at the machine itself, thereby overcoming many inherent difficulties of former schemes. It is possible to obtain flexible control of speed over a 20 to 1 range with this new electronic device. Although the equipment itself is in some cases more costly than the equipment for former methods of control, nevertheless, when the production schedules are taken into account, it is a very economical type of application. The application of this device is in its infancy. It will find greater and greater use where wide-speed range with good regulation is desired in the material handling, machine tool and process control. The General Electric and other companies have similar equipment.

Fluorescent Lighting

Lighting has become a major war-time industry because of the extensive construction program. Fluorescent lighting has become popular because of the fact that it provides over twice the light output per unit of power as does the incandescent light. Also, in the drive to save copper in construction work, higher voltage can readily be used on this type of light, often resulting in a saving of as much as 50 per cent of the copper in the system.

A fluorescent light is an electronic device. A stream of electrons is caused to flow in the gas between two electrodes in the tube which causes certain mineral powders on the inside of the tube to glow or fluoresce. There has been $70,000,000 of business in the lamps alone while the fixtures amounted to $275,000,000 in three years. The peak year was 1941 with a total business of $180,000,000 in fixtures and lamps. Last year the lamp and fixture business amounted to $100,000,000 while this year it will drop to $75,000,000 because of restrictive orders and decrease in the construction program. One of the outstanding development jobs in connection with restrictive orders has been done in this field. The weight of steel in a 2 lamp, 40 watt commercial fixture has been reduced from over 21 pounds to less than this through the substitution of materials and redesign. Work is being done to adapt this type of lighting to home use.

High-Frequency Heating

The use of high-frequency alternating currents for many individual heating jobs is attracting considerable attention at present. The scarcity of tin in particular, accelerated the use of this form of electronic equipment in the saving of tin for tin plate.

When the Japs took over the Far East, conservation of tin became a real problem in this country. Practically half of the tin used in this country goes into tin plate for tin cans so that it was natural to look critically at the tin plate industry. The hot-dip method of applying tin to steel previously used required 1½ pounds of tin per 100 pounds of steel. Electroplating, requiring only ½ pound of tin per 100 pounds of steel or approximately 1/3 of the amount of tin, had been known for some years. However, when used in the plating of tin on steel a porous finish is obtained. This porous finish is objectionable because of the possibilities of vegetable and fruit acids attacking the basic metal under the tin.

The problem was to get a smooth, clean coating of tin that would provide a complete seal from the basic steel. Several schemes were considered, such as electric conduction where current was introduced into the tin plate through rolls. This required considerable additional space in the tinning line and also introduced problems in preventing marking of the tin plate as a result of the current flowing between the roll and the tin plate. Use of heat generated by burning gas was considered, but again this requires a great length in the tin-plate line and introduces difficulties in getting uniform distribution of heat in the metal. Heating the electrolytically tinned surface by electric induction, the high-frequency for which is generated by electronic tubes, overcame these difficulties and has been generally adopted by the steel industry in the last six to nine months.

Who would have thought that the electronic oscillator developed for the broadcasting industry pioneered by Westinghouse some 20 years ago would be the answer to the tin problem of today? The first trial installation of induction heating for the flowing of tin was made with an obsolete broadcasting set and it is still in regular operation. After the tin is electrolytically deposited on the steel it is passed through a coil energized by high frequency of the order of 200,000 cycles per second. The tin melts and flows slightly and when it again freezes it forms a smooth layer 1/30,000 of an inch thick. Designs have been completed for tin flow speeds up to 1300 feet per minute for 30-inch sheets. This is the equivalent of plating both sides of a sheet the size of a football field in 12 minutes.

This is a fine example of how manufacturers must be willing to recognize a rapid change in industry. The need for conserving tin forced the steel companies to change their methods almost overnight. Westinghouse has on order or has installed approximately 48 units totaling 10,000 kw of high-frequency heating in groups up to 1200 kw in the last six months. Three 1200-kw units are being installed in one plant. This total is more than 2½ times the amount of power that is produced by all of the commercial broadcasting stations in the United States today. The high-frequency part of the tinning lines has amounted to approximately $2,000,000 of business.

Although almost all the tin-flow applications have been or soon will be completed, nevertheless, the same principle can be used in the processing of plywood, plastics, heat treatment of metals and the like and certainly this market bids fair to be even larger than the tin-flow market. It is one that will require considerable research as well as commercial adaptation of high frequency to the processes, but its future is certain. There are a number of companies in this field, such as R. C. A., Induction Heating Corporation, General Electric Company, Westinghouse Company and others.

Radio and Communications

Westinghouse is supplying latest electronic equipment for all sorts of wartime needs. Naturally, these developments and techniques are secret. There is a wonderful possible peace-time future for much wartime electronic equipment. It may guide planes over mountain peaks and ships through fog. It may provide a means of dispatching planes in the air and other applications that, because of secrecy, cannot yet be discussed. There are still many ideas for such equipment, in the research and development stages.

Research

Many of the developments in electronics have been conceived in Research Laboratories. The research on welding, tin flow, Precipitron, rectifiers and many secret devices has made possible the com-

mercial development of the electronic device.

One development which is nearing completion in the Westinghouse Research Laboratories is the Mass Spectrometer. This is an Electronic centrifuge which sorts different gases on the basis of their molecular masses just as a cream separator does for a liquid. A complete gas analysis that formerly required days can be done in a matter of minutes. This device bids fair to finding extensive use in the chemical industry as well as in the synthetic rubber production. The application of this device to industrial analysis is being worked out jointly by a number of companies such as Standard Oil of New Jersey, Standard Oil of Louisiana, Humble Oil Company, Shell Development Company, Hercules Powder Company and our Research Laboratories.

Tubes

Quite often we are inclined to think of electronics in terms of vacuum tubes. Tubes are the focal point of the industry but they are a small part of it. There was $7,000,000 of industrial tube business last year and a total of $15,000,000 over the past five years not including the larger Ignitrons previously mentioned.

The circuit equipment necessary to apply these tubes will require from four to 200 times the values of the tubes themselves. Thus tubes amount to a fair amount of business but there is also other types of electrical equipment that is absolutely necessary to make electronics a commercial venture. Radio and special war tube business is, of course, many times this figure.

In discussing the application of Electronics to Industry it is impossible to give a complete review of all possible applications past, present and future. Protection of property, protection of men at machines, instruments of all kinds, industrial X-ray, temperature controls, cathode-ray oscillograph, balancing machines are all acc..nplishments. This phase of the electrical industry is moving at a terrific rate and will continue to do so.

One of the difficulties encountered with the electronics industry in the early '30's was the fact that it was ahead of industrial acceptance. There was not a true appreciation of the limitations of the application of electronics and the headaches that grew out of this resulted in a slowing up of its acceptance in industry. In the meantime, there has been considerable work done of an educational nature not only by the colleges but by industry itself.

The large number of men receiving electronics training in the Armed Forces is also going to create a greater appreciation and acceptance after the War. There is still, however, caution that must be injected into the application of Electronics in Industry. Let us not try to do everything electronically because of its momentary popularity. Let us use it where it does a better or more economical job for industry. Electronics is doing a mammoth job in industry today. Electronics is at work and if we follow this path of caution the future of Electronics in Industry is assured.

Essential Accident Prevention Measures in Design and Maintenance of Substations

(*Continued from page* 328)

he should have to do the job is cut down. He seeks to do faster switching, he shortcuts "hold-off" procedure, he has some men ready to jump on the job before all the checks for live conductors have been completed and before all safety grounds are attached, other men leave to get tools and material off the truck before the clearances are established and come back thinking the conductors are de-energized, or even mistake the equipment upon which work is to be done.

Next, the foreman has all the details of the hurried job to consider. Frequently, in a repair job, it quickly turns up that the damage is greater or different than planned for, additional material and tools are necessary, more time should be allotted but the interruption is limited to the original schedule. Plans have to be rearranged, men reassigned, even the foreman may lend a hand. He naturally concentrates on the problems one by one as they arise, all the time hurrying everyone. Is it any wonder some man makes a wrong "size-up" of the situation, has a mental lapse, even becomes careless? To revert to Mr. Dean's analogy, where is the friendly but imperative traffic cop to blow him down when he steps off the curb of safety into the highway of close clearances? Our cop should be a safety watchman. Then the foreman, while keeping the safety of his men in mind as he plans and executes the job, is relieved of the necessity of constantly watching the moves of every individual workman in his crew; his men work more freely and faster because their safety is assured. Thus the crew, even with one man of their own as their watcher, produces not less but more in a given time and all return home safely.

This watchman cannot be the foreman who has other responsibilities, he cannot be the operator who must be alert to changes in system set-up and answer telephone calls from dispatcher and other employes. He must be a competent workman designated by the foreman and coached by the operator and foreman during the inspection preceding the job, for any unusual or hazardous conditions peculiar to the job Thus he is the one man present who is exerting all his faculties with continued verbal warnings to the prevention of risks which are certain to be incurred by others when distracting influences prevail.

The Way of Accident Prevention is Clear

Mr. Stewart sums up the evidence with this fundamental consideration, "If enough men, no matter how able and experienced they may be, over a long enough period of time, assume positions with relation to unprotected energized parts, such that something unexpected (a fall, a slip, a cutout, a mental lapse) may result in an unprotected part of their bodies coming in contact with such parts, some of these men will eventually establish contact. The way of prevention is clear. It lies in making sure that the individual workman, no matter how experienced, capable or sure of himself he may be, does not assume such position with relation to unprotected live parts."

Having digested this clear statement and having given thought to the part we might take in cooperative committee work of accident prevention, may we then resolve that while our furloughed men fight in foreign lands the hard war against the recognized and worshipped powers of evil who would make all life worthless, that here in our homeland, we will back up those who fight for us by making life even more real and more earnest. In war's stress we can profitably begin to set up our pattern to secure those "inalienable rights of—life, liberty, and the pursuit of happiness."

Some Aspects of Rural Electrification in New York State

By R. G. Harvey
Central New York Power Corporation

THE State of New York has long been a leader in Rural Electrification and the companies in the Niagara Hudson System have taken an active part in the progress which has been made. This state ranks eighth in the number of farms with service available and fourth in the number of farms using central station electric service, according to the United States Census of 1940.

Figures from the Census show that on April, 1940, there were 153,238 farms in the State, of which 115,879, or 75 per cent, had electric service available within ¼ mile and 102,283, or 66 per cent, were connected to electric lines. Over 2,500 farms had no buildings and thus, presumably, had little or no need for electric service, and 10,000 farms are in areas classed by the New York State Planning Board as unsuitable for permanent agriculture and where farms are being abandoned. Subtracting these from the 153,238 farms shown by the Census we have 140,738 farms which ultimately may receive electric service. Thus, according to the Annual Report of the Public Service Commission for 1941, a much higher proportion of the ultimate job of rural line construction had already been accomplished than would appear from the Census figures.

Some of the progress in extending rural lines may be found in the following figures, obtained from reports of utilities to The Empire State Gas and Electric Association and the Public Service Commission:

	1925	1930	1935	1940	1942
Miles of Rural Lines	9,500	18,200	24,705	37,850	39,500
Farms Served	25,400	47,147	61,506	106,531	113,500
% Farms Served	13.4	29.4	34.8	69.5	74.2
Farms per mile	2.6	2.6	2.5	2.7	2.8

It will be noted that the number of farms served per mile of line has not changed substantially over the entire period. The number of non-farm rural customers has decreased steadily as lines have been extended into more sparsely settled territory.

In 1926, the earliest year for which information is available, the average annual use of electric energy by New York farms was 609 kwhr and the average farm cost per kwhr was 10c. In 1940, average annual use had increased to 1,311 kwhr and the average cost per kwhr had decreased to 3.93c.

Electrification of Onondaga County

One of the most completely electrified rural areas is Onondaga County which is far above the State average in farm electrification. The adjoining summary of 1940 census figures shows the extent of electrification in that county.

In the last two years a few more farms have been electrified which would change the 1940 Census figures somewhat.

Rural Electrification Onondaga County Farms—1940 Census

A	B Total Farms	C Farms within ¼ mile of power line	D Farms lighted from power line	E Percent with electricity available C/B	F Percent using electricity D/B	G Percent using electricity when available D/C
Onondaga County Total	4,490	4,170	3,901	93.0	87.0	93.8
Central New York Power Corporation	3,564	3,341	3,140	93.7	88.0	94.0
Niagara, Lockport and Ontario Power Company	280	277	274	98.9	97.9	98.9
Total Niagara Hudson System Companies	3,844	3,618	3,414	94.0	88.8	94.4
New York State Electric and Gas Corporation	618	525	460	84.8	74.5	87.8
Village of Skaneateles	28	27	27	96.5	96.5	100.0

Liberalized Extension Plan

Previous to the war, great strides had been made by Niagara Hudson System's companies farm service in the development and application of electricity to the rural sections of the state served by them. While this program has been temporarily restricted by reason of the war, it is expected that in the post-war period a renewed program for the application of electricity for rural farm needs will be intensified. It is believed that there will then be a largely increased permanent use of electricity by farm customers because of this program and the then available farm appliances and equipment.

In September of this year a liberalized rural line extension plan to assist rural customers in their wartime food production efforts was announced by the president of the Niagara Hudson Power Corporation. The electric operating utilities in this system in New York State now serve approximately 51,000 of the 68,000 farms in the system's franchise area. The plan originally was intended as a part of the system's postwar program for completing the electrification of its rural territory, but it was decided to make the plan available now in view of the current food situation.

Under the new plan, the Niagara Hudson has introduced a liberalized rural electric line extension plan to help farmers in their wartime food production effort. It is one of the most liberal plans of this nature offered in the United States. It will bring to many farmers, who do not now enjoy the benefits of electricity, a valuable service to offset the farm labor shortage through the use of electrically operated equipment for poultry raising, milk production, and for general farm needs.

Under the new plan, farmers living within the area served by the Niagara Hudson System whose farms meet the requirements established by the War

Production Board, may obtain rural electric service by paying a minimum monthly charge of $2.00. After a farmer has taken service for a period of 5 years, his minimum monthly charge is reduced to the minimum charge of the regular "rate schedule."

The new plan reduces to $2.00 per month, for ordinary farm and domestic service, all guaranteed minimum monthly charges now in effect in excess of $2.00 for the unexpired portion of the 5-year guarantee period.

Wartime Activities

Wartime rural electrification activities of Niagara Hudson companies have been largely concerned with helping farm customers keep in operation the electric equipment which they may now own.

For example, in the writer's own company, Central New York Power Corporation, it was found in checking on the equipment which has been in service on farms for years that many of the motor driven appliances were located in dusty places and had not been properly cared for by the owners. Colored slides of neglected motors being used on farm equipment such as milk coolers and milking machines were made, as well as slides of other electric equipment on the farm to show typical examples of what to look for in the maintenance of farm production equipment. These slides were made available to rural service men and were shown at various farm group meetings throughout our territory. Later when the General Electric and Westinghouse Sound Slide films were available, these were used at the meeting in place of our slides.

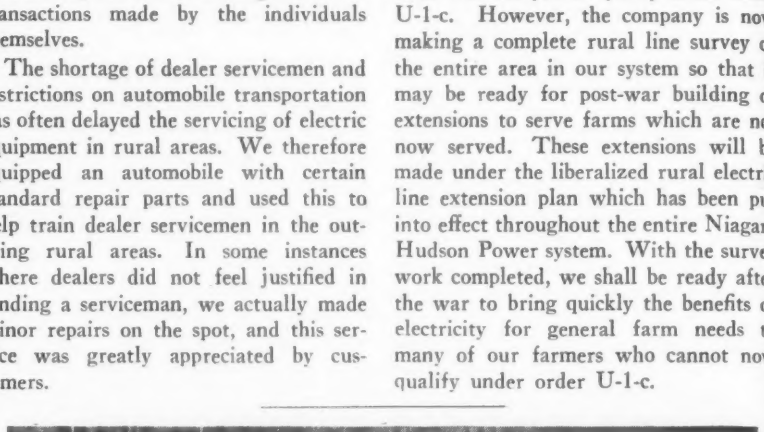
The territory has now been nearly covered with this visual maintenance program and considerable progress made with rural customers in awakening them to the need of taking better care of their present equipment.

While care and maintenance covered one important phase, it was known that there was considerable electric farm equipment idle or not being made use of to the fullest extent. In an effort to render an aditional service to the farmers and the war effort on the home front, the utility is acting as a clearing house for the exchange of equipment. Cards were sent out explaining to the farmer our program and offering our facilities as a channel through which useful electrical farm equipment not in service might be sold or traded. A return postcard was attached, on which the customer could list equipment which he needed and also equipment he was not using and would sell or trade. After collecting this information, requests between the interested parties are exchanged and all transactions made by the individuals themselves.

The shortage of dealer servicemen and restrictions on automobile transportation has often delayed the servicing of electric equipment in rural areas. We therefore equipped an automobile with certain standard repair parts and used this to help train dealer servicemen in the outlying rural areas. In some instances where dealers did not feel justified in sending a serviceman, we actually made minor repairs on the spot, and this service was greatly appreciated by customers.

Post-war Activities

Present line extensions are now being made in accordance with the Office of War Utilities present policy under order U-1-c. However, the company is now making a complete rural line survey of the entire area in our system so that it may be ready for post-war building of extensions to serve farms which are not now served. These extensions will be made under the liberalized rural electric line extension plan which has been put into effect throughout the entire Niagara Hudson Power system. With the survey work completed, we shall be ready after the war to bring quickly the benefits of electricity for general farm needs to many of our farmers who cannot now qualify under order U-1-c.



Agricultural students at a central district school receive first hand information on the importance of frequent cleaning and oiling of electric farm equipment from Harry Gilbert, center, Commercial Service Supervisor of the Lakeshore District of Niagara, Lockport & Ontario Power Company.

In the Avon district of Niagara, Lockport & Ontario Power Company a farm equipment exchange service was instituted late in the summer of 1942. Under the plan letters were sent to farm customers together with a return card on which the farmer could list any used equipment he needed, or any equipment he could dispose of. As the returns were received, requests were matched up with offers and arrangements made to bring the interested parties together. As a result of the success of this trial the company placed similar plans in operation in the other districts which it served.

Under the second step of the new program—motor repair—the company authorized its servicemen to make repairs on farm motors in addition to their regular servicing of ranges, water heaters, and other domestic equipment. Wherever possible repairs are made on customers' premises to save time and transportation costs. If it is found necessary to return the motor to a repair center, an exchange motor is loaned when available to carry on such vital operations as milking and water supply. In addition, upon reinstallation of the repaired equipment, servicemen install new type delayed action fuses to provide additional motor protection in the future.

Cooperating with the farm equipment maintenance program of the Cornell Extension Service, company representatives are assisting at motor repair clinics conducted by agricultural engineers of the university. At the repair schools farmers are invited to bring in electric motors and receive instructions in cleaning, oiling, and reassembling them for maximum service. In the event major repairs are necessary, assistance is given in locating convenient and reliable repair facilities.

Accident Prevention Committee Meeting

H. O. Sprinkle, *Chairman*

THE Fall Meeting of the Edison Electric Institute Accident Prevention Committee was held at the LaSalle Hotel in Chicago, October 8 and 9, 1943. The largest attendance for many years reflected the growing interest in this work and a strong desire to support and intensify all such organized constructive accident prevention efforts.

The 1942 Accident Statistics Report as recently issued was discussed, during which the method of reporting fatal accidents was questioned. In the course of the discussion it was explained that accidents that occur in one month or year but do not become fatal until the next, should be counted in the month or year in which the accident really occurred. It was decided to have the report reviewed and reissued to show trends and to make some corrections that are not expected to alter the basic picture.

The suggestion was made that some extension of the merit award conditions might be desirable beyond the present one million manhour requirements. A sub-committee consisting of Messrs. Godwin and Ruoff was appointed to consider the matter and make recommendations at the next meeting. Contact is also to be made with the American Gas Association to obtain their views.

It was announced that a new 5 x 8 in. pocket-size "Tree Clearance Manual" is now at the printers and is expected to be available shortly as an Edison Electric Institute publication. The manual will deal entirely with tree clearance work, with a brief reference to accident prevention practices. It was felt that it was better to make the manual available in this form as soon as possible rather than delay its publication for the inclusion of detailed accident prevention material, which is still covered in an earlier publication on the subject.

The Chairman announced that the Accident Prevention Committee would probably soon be asked for comments on a proposed report on "Safety Practices for Meter Men." This report is being sponsored by the Meter and Service Committee and is intended to serve as a national guide for meter testers and meter repair men. It was understood that the report is approaching final form and is to be issued as a Safety Manual. At present it is being reviewed by the Editing Committee which has asked individual members of the Accident Prevention Committee for comments on certain safety aspects. Mr. Burton was designated to keep in touch with the Editing Committee.

Mr. H. H. Berman presented a Progress Report of the sub-committee appointed at the May meeting to collect and analyze data on cutout accidents. This has been a major activity of the Accident Prevention Committee. Mr. Berman stated that responses to questionnaires indicated widespread interest in the study. Many offers of help were received and assurances that conferences and meetings would be arranged by individual companies to gather information and suggestions. From data already received, the original list of 27 causes has grown to 91. These and preventive suggestions are now being studied and classified. A concluding report may be expected next spring.

Mr. T. R. Claffy presented a paper on "Rubber Protective Equipment," reviewing the rubber situation as it affects linemen's protective devices. He pointed out that although new plants for the production of synthetic rubber have steadily been coming into production, it is still extremely important that natural rubber be conserved because many important products cannot be made from anything but crude or at least a portion of crude. The trend has been to substitute either synthetic, reclaimed, or scrap wherever possible and specifications are being rewritten accordingly. Rubber gloves are not expected to be affected as their vital importance is widely recognized and experiments with synthetic gloves have not been very successful. In some cases tests have revealed that the dielectric strength of the synthetic product is even better than the crude, but physical requirements make it necessary sometimes to use some natural rubber, depending upon the character of the device.

During the discussion which followed Mr. Claffy's paper, the question was raised whether tests for synthetic rubber blankets should be changed. He said no change was expected. An inquiry about the effect of heat and cold on such synthetic products revealed that a great many improvements had already been made for this particular use, and more were expected. Asked about the prospects for the continued use of synthetics it was pointed out that it takes about twice as long to process them than it does natural rubber. Assurances were given that safe and satisfactory protective devices will continue to be available.

Mr. W. R. Smith submitted a printers proof-copy of a final report on the technique of "Pole Top Resuscitation." He explained that the technique itself was predicated on the original work and experience of the Duquesne Light Company and that the Edison Electric Institute Accident Prevention Committee undertook the preparation of this outline of instructions in the interest of electric light and power companies and others who may wish to train their men in the technique of Pole Top Resuscitation.

The committee members were luncheon guests of Ebasco Services where they were addressed by Mr. N. C. McGowen, President, United Gas Pipe Line Company, on the subject "Management's Views Regarding Safety Activities."

Mr. D. C. Stewart reviewed the results of an analysis he made of detailed reports on fatal and lost-time accidents. He said causes were found to be so numerous and over-lapping that it was considered impractical to present brief specific preventive measures, but that he would like to stress again the importance of using rubber gloves and similar protective equipment where there is any possibility whatever of making accidental contact with live parts, especially when within reach of primary voltages.

Chairman Sprinkle added emphasis to this suggestion by reviewing the history and background of work done by the Accident Prevention Committee in this direction, and urged greater publicity of the facts brought out in this analysis as an aid in developing an increasing awareness of hazardous conditions that so frequently result in such accidents. It was suggested and agreed that a classification of accidents by preventive measures should be prepared. Mr. Beck agreed to sponsor this assignment. Mr. Rue will proceed with the preparation of a hand-book on "Protective Rubber Equipment." It was also agreed that a series of articles grouping the unsafe practices according to degree of importance

and prevalency should be prepared for the BULLETIN.

Mr. E. J. Kreh presented a recommended outline of departmental classifications for use in compiling departmental accident experience.

A statistical summary of 616 lost-time accidents which occurred in the electric light and power industry during 1942 was presented and discussed by Mr. Stewart. A classification by types was included as a part of this analysis.

Mr. W. T. Rogers is to sponsor publicity particularly aimed at preventing those accidents found to be most prevalent according to Mr. Stewart's analysis.

A report on "High Potential Tests on Manila and Sisal Rope" was presented by Mr. H. J. Burton.

Mr. W. R. Smith called attention to a paper presented at the N.S.C. October 6, by Dr. C. K. Drinker, Dean of Harvard School of Public Health. The subject of this paper was "Evidence Pointing to the Need for a Broader view of Accidents Due to Electricity." Mr. Smith said the paper emphasized the importance of steps taken to guard against low voltage electric shocks.

Chairman Sprinkle announced that the next meeting of the Committee would be held February 11 and 12, 1944, in Pittsburgh.

Accident Prevention Committee is Guest of Ebasco Client Companies at Safety Meeting Luncheon

INTEREST in the meetings of safety and personnel representatives of Ebasco client companies which were held in the LaSalle Hotel, Chicago, during the week of October 4th was manifested not only by the number of delegates who attended but by the sustained attendance at all of the planned sessions. Fifty delegates representing 22 client companies and Ebasco Services were present for these meetings which were held in connection with the National Safety Congress. A number of client companies were represented by several operating people in addition to those responsible for their safety and personnel activities. In addition, there were guests in attendance at various meetings, most of whom attended the Ebasco luncheon meeting to listen to an address by Mr. N. C. McGowen, President of United Gas Pipe Line Company. Besides representatives of some of the leading gas, oil, transportation and other utility companies who attended this luncheon, it is believed that the electrical people who attended represent the major portion of the electric industry in the nation. It is interesting to note that of the two guests, representing Cia Cubana de Electricidad, an associated company, one was sent by the employees of that company to receive the award for first place in the Public Utilities Contest and to attend the Ebasco meetings.

Mr. W. T. Rogers, Insurance & Safety Department Consultant, presided at the various meetings. During the meetings Mr. K. R. MacKinnon, Ebasco Operating Sponsor, gave a highly inspiring and educational talk on safety work. Mr. MacKinnon's talk, which was entitled "Ten Years Without Progress—A Challenge to Our Industry," traced the progress of both the electric and the gas industry in the matter of accident prevention and showed graphically the need for greater concentrated effort in order to better the record still further. He pointed out that because of the sustained effort in accident prevention, fatal accidents in the electric industry were reduced by an average of 270 per year over the past twenty years. While he praised the electric and gas industry for their achievements, he deplored the fact that the past ten years have shown little progress. He said that 150 men are still being killed each year in the electric and gas industries, and submitted this as the challenge which must be met.

Electrical Equipment Committee Meeting

R. T. Henry, *Chairman*

THE fall meeting of the Electrical Equipment Committee was held in Cleveland, Ohio, October 11 and 12, with about 50 members and guests in attendance. On Monday afternoon, at a joint session with the Transmission and Distribution Committee, there was further discussion of plans for the post-war period.

A formal report on Apparatus Troubles for the period February 15 to August 15, was presented by Mr. F. S. Brown. This report covered a total of 152 cases, of which 25 were classified as major and 127 as minor. The average number of failures for this period is 25 per month, as compared with a five-year average of 19.5. Of the major cases of trouble those reported most frequently were instrument transformers (5), power transformers (4), constant current transformers (4), and oil circuit breakers (4). Among minor troubles those occurring most frequently were power transformers (14), lightning arresters (13), constant current transformers (11), and bushings (11). Following the formal report there was a round table discussion of various apparatus troubles including a report on further experience with air blast breakers.

A summary of oil fire reports was presented by Mr. Sels on behalf of Mr. Conwell, sponsor of this project. One of the cases of particular interest was presented in some detail by a representative of the company concerned.

The work of the AIEE-ASME Joint Committee on turbo generator standardization was reviewed by Mr. Oldacre, Chairman of the AIEE Group. Since the AIEE Group had been appointed only a few months ago, the preparation of recommendations in regard to generators had not yet progressed very far. He mentioned a number of factors the committee planned to consider. In response to his request for comments, there was considerable discussion particularly with reference to power factor, short-circuit ratio and reaction on stability.

Mr. Crippen announced that the report of the AIEE Subcommittee on emergency measures to increase the output of generating systems, which had been discussed at the Chicago meeting, had subsequently been published. In this connection he mentioned that there has been considerable interest in the possible advantages of heating up the rotors of large 3600 rpm machines before putting them on the line.

Kilovar supply on the Public Service Electric and Gas Company system was discussed by Mr. Sels. His paper, which appears elsewhere in this issue, presents the engineering features of the problem and indicates the relative economics of various methods of kilovar supply on this particular system.

Mr. Dryar discussed the effect of weather on system load estimating. He presented a considerable amount of statistical information applicable to his system and explained the method which had been developed for making quantitative allowances for the various factors involved.

Mr. Wilbraham called attention to WPB Order R-1 restricting use of rubber for wire insulation, and pointed out it was probable that by the first of the year synthetic insulation would largely replace rubber.

Mr. Fitch described essential accident prevention measures in the design and maintenance of substations. His paper is reproduced in this issue of the BULLETIN.

On behalf of Mr. Howery, Mr. Silver reported on the plans of the Meter and Service Committee for the coming year. Attention will be concentrated on the problems resulting from present war emergency conditions. Also, a subcommittee has been appointed to give consideration to the metering situation after the war, and to appraise new needs, new materials, and new methods that may be at hand as a result of war period research and development.

Mr. F. S. Brown and Mr. W. H. Jones gave a comprehensive description, well illustrated with lantern slides, of the electrical and mechanical features of the Frank R. Phillips Station of the Duquesne Light Company. Following the presentation there was considerable discussion of a number of features of particular interest to the committee members.

A paper on Field Troubles on Synchronous Machines was presented by Mr. Birckhead. He reviewed the types of failures that might occur, and the accompanying effects on the machine and the system under various conditions. A brief description was given of a relaying scheme which could be used for giving an alarm or tripping the machine in case of loss of field.

Joint Session of T and D and Electrical Equipment Committee

At the afternoon Joint Session of the Transmission and Distribution Committee and the Electrical Equipment Committee with Mr. L. R. Gaty, General Engineering Group Sponsor presiding for the Transmission and Distribution Committee, Mr. J. F. Gaskill presented a paper on "Post-War Loads from a Sales Viewpoint." He discussed approaches to selling and stressed the necessity for tying in such efforts with engineering because of changing load conditions as industry converts to peacetime activities. He pointed out that as the industrial war-time load falls off, the commercial and residential loads may be expected to rebound with the removal of war-time regulations and restrictions. Various suggested ways by which advance planning could help meet the change in conditions included:

1. Begin long-range planning now where this has not already been started.
2. Study general engineering needs and possible system changes.
3. Review stocks and standards.
4. Try to reduce the number of stock items.
5. Eliminate non-standard items.

Mr. Gaty discussed "Post-War Problems With Particular Emphasis on the First Year," and directed attention to the problem of absorbing returning employees promptly after the war. He suggested that the industry consider this well in advance and told of some companies that were already developing plans for definite system improvement projects that would help. Mr. Sanford thought that while there might be some unemployment at first, management could minimize this by following conditions closely and planning accordingly.

Mr. H. P. Seelye reported on the progress of the work of the EEI-NEMA Joint Committee on Preferred Voltage Ratings. This committee had first directed its attention to the matter of utilization voltage. Information supplied in the report on this subject prepared by the Electrical Equipment and Transmission and Distribution Commit-

tees served as a basis in the work of the joint committee. Considerable attention has been devoted to more definite establishment of fundamental principles and definitions. The committee also sponsored a survey of voltages on distribution and transmission systems throughout the country to determine the actual range of operating voltages existing. At a recent meeting the committee prepared a list of nominal voltages with corresponding voltage spreads for normal operation. This will serve as a base in the development of ratings for specific types of equipment.

Mr. L. W. Clark reviewed the tentative report on Electric Welding submitted by the Technical Sub-Committee of the Electrical Committee N.F.P.A. This report is the result of requests that a paragraph or section covering resistance welder installations be added to the National Electric Code. One of the main reasons for this is that because of the intermittent character of the load, it is difficult to apply existing Code rules which were written to cover ordinary power and light installations. The report includes a general description of the resistance welding process, its loading characteristics, adequate supply conductors and overcurrent protection. One section is devoted to transformer-type and motor generator-type arc welding sets.

A report on "Blown Fuses Resulting From Shunt Capacitor Application on Welders," prepared by Mr. B. M. Jones and Mr. C. N. Clark was presented. This report described difficulties encountered and satisfactory corrective measures taken in a few cases where shunt capacitors were used to improve the power factor of arc welding loads in both large and small industrial plants.

Transmission and Distribution Committee Meeting

Frank Sanford, *Chairman*

THE Autumn Meeting of the Transmission and Distribution Committee was held at the Hotel Cleveland, Cleveland, Oct. 11 and 12, 1943. The large attendance at all sessions attested to the very lively interest being taken by all operating companies in meeting and solving current war-time problems and in developing plans for the post-war period.

The morning session of the first day with Andrew Bodicky, Underground Group Sponsor presiding, was devoted to problems and matters of special interest concerning underground construction and maintenance.

Mr. W. F. Nimmo presented a paper entitled "38-Kv Low Pressure Gas-Filled Cable Installations, Norfolk, Virginia," dealing with the reasons for choosing this type of cable and the problems met and solved during the installation of some 4000 feet of it. The cable was installed in existing 4-inch fibre conduits, mostly through a thickly populated area. Many of the manholes were small, and to avoid all new construction possible, sections running to a maximum of 450 feet were used to bypass the smaller manholes. To get sufficient room for joint assembly, splicing sleeves had to be slightly shortened in some cases and in two manholes even had to be cut into two parts in order to have it out of the way while assembling the joint. While the cable was being installed it had to be kept full of super-dry nitrogen gas under positive pressure. The completed line was subjected to a gas flow test, a gas pressure test of 20 pounds per square inch, and a voltage acceptance test of 38 kv between conductors (a higher voltage was not available). The cable is constructed to operate at an average gas pressure of approximately 12 pounds and the pressure is governed by a regulator set to feed gas if the pressure falls to 9 pounds. Should pressure drop below or go above predetermined levels an alarm bell sounds in the power plant. The cable has been operating since mid-summer and is giving satisfactory service. Following the presentation of Mr. Nimmo's paper a motion picture was exhibited showing the steps in making up a straight joint and a terminal installation in the field.

Dr. R. S. Wiseman told of the progress being made in research work to determine maximum conduit temperatures and heat correction factors.

Increased use of synthetic-jacketed cables was indicated by reports of successful experiences with Neoprene jacketed cable for primary voltages.

Other subjects discussed during the morning session included:

Migration of Oil Under Pressure—Mr. G. B. McCabe.

War-Time Practices That May Be Extended Into the Post-War Period—Mr. E. W. Oesterreich.

Satisfactory Duct Splicing of 6.6 Kv Lines—Mr. H. P. Seelye.

Submarine Cable Failure—Mr. W. F. Nimmo.

Overhead Ratings and Annealing Temperatures—Mr. L. F. Hickernell.

At the Tuesday Morning Session the Committee Chairman reviewed the activities of the Transmission and Distribution Committee and the prospects for the meetings of this administrative year. He stated that for the past two years the committee had been chiefly concerned with questions of emergency methods, substitute materials, and how to get along without regular supplies. He said it now seemed desirable to start thinking about such pertinent questions as the following:

1. What pre-war practices have been shown to be inadequate or unecessary.

2. What practices proved economical and adequate under the pressure of war-time conditions.

3. What pre-war practices that had to be dropped under war-time conditions should be resumed as soon as possible.

4. What construction projects, deferred maintenance programs and system extensions can be started as soon as the war stops so that returning men may be quickly absorbed into regular employment.

He then suggested that it was a good time now while stock piles were depleted to check cable, wire and hardware items usually kept on hand and to try to reduce their number in the interest of better prices and lower costs.

New Group Sponsors for this year are:

Underground—Mr. Andrew Bodicky, St. Louis, Mo.

Overhead — Mr. W. E. Gundlach, Milwaukee, Wis.

General Engineering—L. R. Gaty, Philadelphia, Pa.

Standards and Specifications—T. J. Brosnan, Buffalo, N. Y.

The General Engineering heading is new. It is intended to center under this

sponsorship various activities such as voltage and load factor studies, coordination, economics and post-war load possibilities.

Mr. Nimmo reviewed an interim report prepared by a subcommittee of the American Research Committee on Grounding, summarizing the activities of this committee since its formation.

Mr. Alexander Maxwell reported on the status of the suggested standard form of Railway Crossing Agreements and Recommended Specifications. He stated that so far only a few replies had been received from questionnaires sent out and that there were still a number of companies to be heard from. Similar results were reported on efforts to obtain agreement on proposed changes to the specifications for the Construction and Maintenance of Jointly Used Pole Lines Carrying Supply and Communication Circuits.

A discussion of the various methods in use for meeting O.C.D. blackout requirements revealed that these practices varied according to the type of installation from the remote control of large groups of street lamps to hand control with simple adaptations to enable wardens to turn off and turn on small groups and individual lamps easily and quickly. Existing series circuits and cascaded series circuits controlled from other series circuits permit almost instantaneous control from stations or sub-stations. Other circuits normally controlled by time clocks or photo sensitive relays require control or pilot wires for central switching. Where this has been impracticable such circuits have been supplied with looped-in, hand operated switches intended for manual operation by air-raid wardens or other designated persons. Throughout the discussion it was evident that operators of street lighting systems are fully alive to the requirements. They are cooperating with local O.C.D. officials in taking measures to meet local situations and are constantly studying possible ways for further improvements within the means available.

It was announced that a new 5″x8″ pocket-size Tree Clearance Manual is now with the printers and is expected to be available shortly as an Edison Electric Institute Publication.

Mr. A. E. Curtis, Jr., described with the aid of lantern slides an experience his company had in August of this year when a windstorm which reached a velocity of approximately 100 m.p.h. severely damaged a 2100 foot span between two anchor towers. The towers themselves were not damaged but three 795,000 cir. mil. ACSR conductors were torn loose from the tower at one end and two conductors from the other end of the span. The conductors themselves did not break. The failures occurred at the insulators and hardware. The scene of the trouble was 2½ miles from the nearest railhead. The repairs were completed in 1½ days.

During a round table discussion of troubles experienced with distribution equipment it was revealed that about 90 per cent of such trouble was due to minor causes requiring small material items. Several companies reported having arranged to study and analyze interruption causes, grouping them by types and areas, and then concentrating on those of highest frequency. Periodic check-ups are made of such surveys. One company is encouraging its customers to use "time-delayed" fuses. This company replaces only such fuses and is finding the practice aiding considerably in reducing outages. A review of grounding practices in the case of pole mounted transformer tanks indicated that about one-third of the companies represented, ground the cases of transformers operating below 5 kv and that the majority ground all operating above 5 kv.

Records kept by one company on transformer fuse blowings showed that the blowing rate dropped rapidly as the size of the fuse was increased. The blowing rate was reported to be seven times as great for 5 amp. primary fuses as it was when they used 7.5 amp.

Testimonial to A. B. Campbell

A closed session was held in the afternoon during which the following resolution was passed in tribute to Mr. A. B. Campbell's services to this committee and its predecessor during the past 20 years:

> Allan Berry Campbell long has been a diligent and faithful worker for our Utility Industry and for this Transmission and Distribution Committee and its predecessor. Effective June 30, 1943, after a tenure of twenty years, he resigned as Engineer of Edison Electric Institute for an opportunity to utilize his broad experience and personal acquaintance in the commercial engineering field.
>
> He was graduated from University of Illinois in 1909 with degree of Electrical Engineer. From 1909 to 1915 he was employed by Bullock Electric Company and Western Electric Company. He was a Member of the Faculty of Iowa State College from 1915 to 1920 and Electrical Engineer of the Iowa Railroad Commission from 1920 to 1923.
>
> He is a Fellow of American Institute of Electrical Engineers and Member of National Safety Council, National Fire Protection Association, American Society for Testing Materials, and American Wood Preservers Association. During his twenty years with National Electric Light Association and Edison Electric Institute, he has served in varied responsible capacities, such as Engineer of the Institute, Secretary of Accident Prevention Committee, Member and oftentimes Secretary of joint industry committees, and especially as Secretary of this Transmission and Distribution Committee. He has rendered great service to carrying forward the National Electric Safety Code, the National Electric Code, Safety and Electrical Codes of various States and of some foreign countries.
>
> His work for our industry has been instrumental in advancing joint use of facilities, in furthering safety practices, in standardizing of poles, insulators, wires, cables, transformers, galvanizing, wood-preserving and other materials and processes for usage in electrical construction and for rendering electric service.
>
> Best known as Berry or "Barry," he is an indefatigable worker, duffer golfer, tolerable dancer, unnerving back-seat driver, genial imbiber, master preparer of viands, accomplished narrator of jokes, boon companion, exemplary husband and father, gentleman, fine citizen, and in every respect a real American.
>
> So, be it RESOLVED:
>
> That appreciation for his valuable work, together with the esteem and best wishes of the members of this Transmission and Distribution Committee of Edison Electric Institute be evidenced by rising vote.
>
> That this resolution be incorporated in the Minutes of this meeting and printed in the Institute Bulletin.
>
> That a copy of this resolution be presented to Allan Berry Campbell.
>
> Oct. 12, 1943.

Chairman Sanford in closing the meeting declared it one of the most fruitful and informative yet held.

Check List and Status of EEI Standards and Specifications

Prepared by E. V. Sayles for Transmission and Distribution Committee, EEI, October, 1943

SOON after the organization of the Transmission and Distribution Committee, Edison Electric Institute, the Standards and Specifications Group outlined a program for reviewing, revising, or superseding the rather substantial number of specifications issued by the NELA and for the most part included in the Overhead Systems Reference Book and NELA Serial Report of 1929. In addition, the Standards and Specifications Group undertook the preparation of such new standards or specifications as are considered necessary. The following summarizes the progress made to date.

General Summary of Standards and Specifications Prepared

At various times during the past ten years, a summary of the current status of this work was presented to the Transmission and Distribution Committee and included in the minutes. The last complete summary was included in the minutes of the October, 1940, meeting. The following is a summary of the present status:

NELA Specifications superseded by EEI Specifications	47
NELA Specifications superseded by ASTM Specifications	5
NELA Specifications yet to be superseded by EEI Specifications	21
NELA Specifications to be discarded	20
Total NELA Specifications published	93

Specifications Published to Date

The following is a list of the completed specifications prepared by the Transmission and Distribution Committee:

TD-1-1937	Suggestions for Specifications for Bolts and Nuts
TD-2-1942	Suggestions for Specifications for Strand Eye Anchor Rods
TD-3-1938	Suggestions for Specifications for Lag Screws
TD-4-1939	Suggestions for Specifications for Eye Bolts
TD-5-1941	Suggestions for Specifications for Eyenuts and Eyelets
TD-6-1940	Suggestions for Specifications for Steel Crossarm Braces
TD-8-1940	Suggestions for Specifications for Straight Tinned Copper Connectors
TD-9-1942	Specifications for Single Tube Seamless Copper Splicing Sleeves
TD-10-1940	Suggestions for Specifications for Rolled Steel Washers
TD-51-1937	Suggestions for Specifications for Low and Medium Voltage Pin Type Insulators
TD-51-1943	Specifications for Low and Medium Voltage Lime Glass Insulators (Supersedes the glass insulator portion of TD-51-1937)
TD-61-1940	Suggestions for Specifications for Type "A" Untreated Douglas Fir Crossarms
TD-62-1940	Suggestions for Specifications for Type "B" Untreated Douglas Fir Crossarms
TD-71-1937	Suggestions for Specifications for Insulator and Pin Threads and Gauges

Jointly Prepared Standards and Specifications

The above summary includes only specifications prepared and published by the Transmission and Distribution Committee. In addition, the committee has prepared jointly with others reports which contain standards or specifications. These include:

EEI-NEMA Standards for Distribution Transformers
EEI-NEMA Standards for Distribution Cutouts and Fuses
EEI-NEMA Standards for Street Lighting Equipment

Specifications Partially Completed

The following is a list of partially completed specifications:

TD-11	Specifications for Guy Hooks
TD-12	Specifications for Pole Guards
TD-13	Specifications for Guy Thimbles
TD-14	Specifications for Staples
TD-15	Specifications for Pole Steps
TD-16	Specifications for Guy Plates

Specifications to Be Prepared

The following list includes specifications yet to be prepared but not started. This list will be enlarged from time to time to cover any new specifications that are required:

Specifications for Steel Insulator Pins for Crossarm Mounting
Specifications for Steel Insulator Pins for Pole Top Mounting
Specifications for Secondary Racks
Specifications for Low and Medium Voltage Pin Type Porcelain Insulators (To supersede the porcelain insulator portion of TD-51-1937)
Specifications for High Voltage Pin Type Porcelain Insulators
Specifications for Porcelain Guy Insulators
Specifications for Porcelain Spool Insulators
Specifications for Porcelain Wire Holder Insulators
Specifications for Southern Pine Treated Crossarms
Specifications for Southern Pine Treated and Untreated Timbers
Specifications for Fir Treated and Untreated Timbers

Pennsylvania Electric Association Meeting

THE post-war era in America, and what it may hold for the electric industry was the dominant subject of speakers at the 36th annual meeting of the Pennsylvania Electric Association, held at Pittsburgh, Sept. 23.

P. H. McCance, president of the Duquesne Light Company, was elected president of the association for the coming year, succeeding E. H. Werner, of the Pennsylvania Edison Company of Altoona. Vice-presidents elected were Francis McQuillin, West Penn Power Company; George E. Whitwell, Philadelphia Electric Company, and M. H. Parkinson, Pennsylvania Power and Light Company.

Governor Edward Martin of Pennsylvania, guest speaker at the dinner meeting, told the 500 members present that the Government must not be allowed to become too powerful and overcentralized. "This growing centralization," said Governor Martin, "means more bureaus, agencies and commissions. It is giving us a government by men rather than a government by law." He said that the Federal payroll is now "50 per cent greater than the estimated combined payrolls of all the 48 states." In conclusion, Governor Martin urged consideration now for the cost of government after the war and stressed that "we must all take part in the government."

Carl L. Peirce, Jr., president of Hubbard and Company, welcomed the members to the meeting and nominated employees of the electric industry "to receive the All-America 'E' for a job well done for all America."

After reviewing the association's activities during the past year, President E. H. Werner urged utilities to be mindful of the future. The requirements of peace will be great, he said, and progress should continue unabated.

Wheeler McMillen, editor-in-chief of *Farm Journal* and the *Farmer's Wife*, spoke on "The Rural Routes of Industry." He stated that if the electrical industry is going to remain in private hands it will be only because all who believe in it take the trouble to make it work. "Private enterprise," he said, "can survive only by expansion. You must provide better service to more and more people at less cost."

Other speakers at the morning session

(*Continued on page* 352)

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	Members	Non Members
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Digest of Authoritative Opinions of the Definition of Original Cost (Including Appendix on "Prudent Investment") 1938	$1.50	$1.50
Proceedings 1942 Meeting of Gas and Electric Accountants	1.00	1.00
Proceedings—National Accounting Conferences		
Complete Set—6th Conference 1942	1.00	1.00
" " 5th " 1941	2.00	2.00
" " 4th " 1940	2.00	2.00
" " 3rd " 1939	2.00	2.00
" " 2nd " 1938	1.50	1.50
by Groups Yearly—		
Classification of Accounts	.50	.50
Customer's Relation	.50	.50
Depreciation	.50	.50
Plant Accounting and Records	.50	.50
Purchasing Stores & Transportation	.50	.50
General Sessions	.50	.50
Summary of Definitions Covering Depreciation and Related Terms 1939	1.00	1.00
Statistical		
Electric Light and Power Industry in 1942 (6/43)	.75	.75
J-2—Electric Light and Power Industry in 1941 (5/42)	.30	.75
I-2—Electric Light and Power Industry in 1940 (5/41)	.30	.75
(Statistical Bulletins also available for years 1932 to 1939 inclusive) each	.30	.75
Weekly, Monthly and Annual Statistics (Includes Annual Statistical Bulletin; Weekly Electric Power output; Monthly Electrical Research Statistics).	2.00	2.00

Engineering Committees

ACCIDENT PREVENTION—RESUSCITATION

K-8—Pole Top Resuscitation (9/43)	.10	
(Quantity Prices on Application)		
J-9—1941 Accident Statistics of Electric Light & Power Industry (12/42)	.10	.25
F-10—Tree Trimming Practices (10/38)	.20	.50
E-12—Resuscitation Booklets (7/37) 1— 9 copies	.10 each	
10— 99 "	.08 "	
100—499 "	.06 "	
D-18—Your Unseen Helper (1936) 1,000	$10.	
5,000	30.	
10,000	50.	
C-14—Resuscitation Charts (4/36)	.10	.10
C-12—Twelve Messages on Accident Prevention in the Electric Public Utilities (12/35)	.10	.10

ELECTRICAL EQUIPMENT COMMITTEE

F-13—Reconditioning Flood Damaged Electrical Equipment (12/38)	.30	.75
F-5—Design of Switchhouses for Generating Stations and Transmission Substations (6/38)	.40	1.00
E-1—Rectifier Wave Shape (4/37)	.40	1.00
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B-10—Electrical Energy Diversion (10/34)	.20	.50

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A-19—Hydraulic Governors (8/33)	.20	.50

JOINT REPORTS

K-1—Volume 5 of Engineering Reports Nos. 39 to 49 of Joint Subcommittee on Development and Research (1/43)	5.00	10.00
J-8—Utilization Voltage Standardization Recommendations (10/42)	.20	.50
J-6—Wave Shape of Multi-Phase Rectifiers—Engr. Report No. 49—Joint Subcommittee on Development and Research (8/42)	.50	1.25
J-4—Low Frequency Shielding in Telephone Cables—Engineering Report No. 48—Joint Subcommittee on Development and Research (5/42)	.80	2.00
J-1—Positive Disconnection of Distribution Circuits During Faults to Ground—Engineering Report No. 47—Joint Subcommittee on Development and Research (4/42)	.60	1.50
I-9—Standards for Distribution Transformers (Second Report) EEI-NEMA (12/41)	$0.25	$0.60
I-8—Susceptiveness of Subscriber Station Sets—Engineering Report No. 46—Joint Subcommittee on Development and Research (12/41)	.60	1.50
I-7—Frequency Weighting for Message Circuit Noise—Engineering Report No. 45—Joint Subcommittee on Development and Research (12/41)	.20	.50
H-12—Neutralizing Transformers—Engineering Report No. 44—Joint Subcommittee on Development and Research (7/41)	.30	.75
H-10—Effects of Bonding Exchange Aerial Telephone Cable Sheaths to Multi-Grounded Power Neutrals—Engineering Report No. 43—Joint Subcommittee on Development and Research (6/41)	.30	.75
H-8—Standard Basic Impulse Insulation Levels — AIEE-EEI-NEMA (1/41)	.05	.05
H-3—Inductive Coordination Aspects of Petersen Coil Grounding—Engr. Report No. 42—Joint Subcommittee on Development and Research (12/40)	.25	.65
H-1—Test Specifications for Household Electric Ranges—EEI-NEMA (5/40)	.20	.50
G-9—Methods of Measuring Radio Noise—EEI-NEMA-RMA (2/40)	.20	.50
F-17—Short-Circuiting Relay Protectors—Engr. Report No. 41—Joint Subcommittee on Development and Research (8/38)	.40	1.00
F-8—Test Specifications Automatic Electric Storage Water Heaters—EEI-NEMA (10/38)	.20	.50
F-2—Inductive Coordination of Rural Power and Telephone Systems—Engr. Report No. 40—Joint Subcommittee on Development and Research (1/38)	.80	2.00
E-9—Characteristics of Power System No. 39—Joint Subcommittee on Development and Research (11/37)	.60	1.50
E-5—Principles and Practices for Inductive Coordination, EEI-AAR (1/37)	no charge	no charge
E-4—Joint Use of Poles 6.6 and 13.2 kv. Safety Features—EEI-Bell Tel. (1/37)	.30	.75
E-3—Jointly Used Wood Pole Lines Specifications—EEI-Bell Tel. (1/37)	.50	1.50
Power Level and Sensitivity of Telephone Circuits—Engr. Report No. 38—Joint Subcommittee on Development and Research (1936)	.40	1.00
Computation of Zero-Sequence Impedance of Power Lines and Cables—Engr. Report No. 37—Joint Subcommittee on Development and Research (1936)	.80	2.00
Selected Devices for Reducing Harmonies in Fower Systems—Part II—A-C Systems—Engr. Report No. 34—Joint Subcommittee on Development and Research (1936)	.80	2.00
D-14—Vol. IV—Engineering Reports of the Joint Subcommittee on Development and Research (1/37)	5.00	10.00
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F-14—Turbines, Condensers and Pumps, 1938 (12/38)	.70	1.75
F-12—Combustion, 1938 (11/38)	1.00	2.50
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K-4—A-C Network Operations, 1938-1940 (4/43)	.60	1.50 1.60
J-5—Ice and Wind Loading Tables for Overhead Line Conductors (Revision of Tables 85 to 96 of the Overhead Systems Reference Book) 1942	1-4 copies 10c.	
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Lighting Booklets		
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Better Light—Better Sight—Better Living	$1.50 per 100	
Better Light—Better Sight—Better Sales	$1.50 per 100	
Priceless Eyes	2.50c	2.50c
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"Light Up—Step Up"—(Industrial) sound slide 15 minutes, 75 pictures	$10.00	" " "
"You Can Do Something About It"—(Home) sound slide, 15 minutes, 95 pictures	$10.00	" " "
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Rewiring for Commercial and Industrial Buildings	$0.25	$0.25
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Good Radio Reception (1937)	100 copies	4.00
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Objective Type Rates, 1933-1936	.80	2.00
Ice and Wind Loading Tables for Overhead Line Conductors (Revision of Tables 85 to 96 of the Overhead Systems Reference Book) 1942	1-4 copies	10c.
	5-49 "	6c.
Power Sales Manual (1941)	3.50	5.00
Rate Book for 1942	10.00	25.00
Rewiring for Commercial and Industrial Buildings (1941)	.25	.25
Sales Training Manual—Commercial Electric Cooking (1941)	1.50	1.50
Storm Loading and Strength of Wood Pole Lines and a Study of Wind Gusts (1936)	2.00	5.00

Periodicals

Better Light—Better Sight News (9 issues yearly)	$0.75	$0.75
Edison Electric Institute Bulletin (Monthly)	2.00	2.00
Rural Electrification Bulletin (5 issues yearly)		1.00

Postwar Loads from a Sales Viewpoint

(*Continued from page* 323)

This will undoubtedly increase our rate of new business increase in this group for a while and may cause some concern with reference to commercial circuits before the end of the period we are considering.

(c) It seems to me that the residential areas with their lighter distribution circuits offer a greater problem to you from the viewpoint of new business. The range and water heater are good pieces of equipment which give nearly trouble-free service when compared to other fuels. They represent a large percentage increase in the load of individual homes. If many of either are sold, and I believe they will be, the resultant circuit load may be worth your consideration. There is also a demand for equipment in this classification which will be released when restrictions are removed. Furthermore, the building of new homes is a natural for the use of credit. It is not unreasonable, in view of the claimed shortages of houses, to expect considerable credit supported construction after the war which will require some extensions.

(d) The overall amount of new load in all classifications which can be sold is dependent entirely on business conditions. Business conditions in turn are, I believe, dependent on the flexibility with which prices respond to demand and the ability to adjust costs to those prices. The use of credit to overcome an impasse in these relationships is now a familiar process.

It is obvious, therefore, that if, as has been assumed, credit will be used to support trade in the first few years after the European war, the volume of new business will be extremely sensitive to the degree and effectiveness of that use. I think this is true because new ventures do not flourish in atmospheres where old business continues out of necessity or hope.

In conclusion I would like to point out that your problem and mine have something in common.

I feel that, in order to uncover postwar markets, we must make careful studies of the loads and needs of customers. This will permit the direction of sales to the most vulnerable part of the market.

It occurs to me that surveys of this type might develop information with respect to specific loads and feeders which would be helpful to you in your postwar preparation. It would not, by any means, be accurate because it would be distorted by the hopes and wishes of the customer. It might, however, indicate some situations which require consideration.

EEI Publications

A catalog of all EEI publications is available upon request to

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PERSONALS

THOMAS W. MARTIN, president of the Alabama Power Co., has been appointed regional vice-chairman for the southern area on the Committee for Economic Development.

ALBERT S. CORSON has been elected vice-president, and JOHNS HOPKINS treasurer of the United Gas Improvement Co., effective Nov. 1. ERNEST G. WINDLE was appointed assistant to the president and GEORGE J. BANSE general auditor, the position formerly held by Mr. Corson.

HARRY J. BURTON, who has engaged in safety work for the Consumers Power Co., Jackson, Mich., has been appointed general safety supervisor. In this capacity, Mr. Burton heads a reorganized safety department which will promote safety throughout all departments and divisions of the company.

WALTER A. BUCHANAN, manager of the Welch (W. Va.) district of the Appalachian Electric Power Co. for a number of years, has resigned to join the Island Creek coal interests in Huntington. SAM R. PRITCHARD has been appointed acting district manager at Welch to succeed Mr. Buchanan. Mr. Pritchard has served as assistant district manager for the past year. Mr. Buchanan will become general manager of the Island Creek Fuel & Transportation Co., a wholly owned subsidiary of the Island Creek Co., one of the largest producers of bituminous coal in West Virginia.

WALKER L. CISLER, assistant chief engineer, electric engineering department, Public Service Electric & Gas Co., Newark, N. J., has tendered his resignation, effective October 1, to join the Detroit Edison Co.

EDWIN H. SNYDER, formerly assistant to the chief engineer, electric engineering department, has been appointed assistant chief engineer, to succeed Mr. Cisler.

Mr. Cisler was lent by Public Service to the Office of War Utilities in September, 1941. He has performed valuable service in directing production scheduling and in other relationships with electric power equipment manufacturers and expects to continue on this assignment until the first of the year, at which time he will take over his new duties in Detroit.

Following his graduation from Cornell University in 1922, Mr. Cisler entered the employ of Public Service as a cadet engineer in the electric department. He has had broad operating experience, having acted in a wide variety of capacities, among them being first assistant engineer, Marion generating station; test engineer, Kearny generating station; assistant chief engineer, Paterson generating station; assistant chief engineer, Marion generating station, planning and installation engineer, electric department; general superintendent of generation, and assistant general manager.

Other changes in Public Service's electric operating department have been announced as follows:

PHILIP H. HARTUNG, from superintendent, Kearny Generating Station, to assistant general superintendent of generation, General Office.

RICHARD S. HOPKINS, from chief engineer, Kearny Station, to superintendent, Kearny Station.

LEROY A. BROWN, from chief engineer, Perth Amboy Generating Station, to chief engineer, Kearny Station.

EARL C. MCMAHON, from engineer to chief engineer, Perth Amboy Station.

Mr. Snyder has been with Public Service since Sept. 17, 1923, when he started as a cadet engineer, Electric Department, a few months after being graduated from Lehigh University. On June 1, 1926, he was assigned to the distribution engineer's office in Newark and later was placed in charge of a planning group in that office. On Jan. 20, 1937, he was promoted to assistant to the chief engineer in the Electric Engineering Department.

Starting with the company July 2, 1923, as a cadet engineer after being graduated from Lehigh University, Mr. Hartung was made assistant engineer at Kearny Generating Station, July 1, 1926; test engineer at Essex Station three years later; fuel engineer, electric generation department, in 1934; load schedule engineer in 1935; chief engineer at Kearny Station in 1936; and superintendent there a year later.

Mr. Hopkins, upon being graduated from Stevens Institute of Technology, started with Public Service June 23, 1919, as a cadet engineer. In 1921 he was made technical assistant at Burlington Generating Station and four years later became foreman, boiler repairs, first at Essex Station and later at Kearny Station. In 1926 he was promoted to first assistant engineer at Kearny Station, later becoming boiler room engineer and then chief engineer at that station.

A graduate of Lehigh University, Mr. Brown was employed by the company as a cadet engineer, July 1, 1926, and was assigned to the test department at Essex Station in 1929. About seven years later, he was made test engineer at Kearny Station and in 1940 was promoted to chief engineer, Perth Amboy Station.

Earl C. McMahon, a Massachusetts Institute of Technology graduate, started with Public Service in 1926 as a cadet engineer and in 1929 was assigned to the test department at Kearny Station. The following year he was made engineer-loads, generation department and 10 years later became assistant engineer in that department. In July, last year, he was promoted to engineer at Perth Amboy Station.

JAMES H. (SCOTTY) MACBETH, general purchasing agent for Southwestern Gas and Electric Company since 1925, will retire from active duty with the company Nov. 1. Macbeth was succeeded by John Rieves, present traffic manager and assistant purchasing agent who joined the company in 1923.

Mr. Macbeth had his first business experience with the American Pipe and Construction Company of Philadelphia in 1902 and has had wide experience in various business fields. He went to Detroit in 1919 as district sales representative for the Midwest Company. In 1922 he joined the Dawes interests of Chicago with duties of supervising purchasing, maintenance and transportation.

In 1925 when the Dawes interests were sold to Insull, he became general purchasing agent for the company.

SAM SCHWIEGER, for five years secretary-manager of the Arkansas Press Association and recently editor of the *Northwest Arkansas Times,* Fayetteville, Ark., succeeded Arthur J. Kane, as advertising manager of Southwestern Gas and Electric Company October 15. Mr. Kane resigned his position to enter

private business in his home town, Baxter Springs, Kans. Prior to coming to Arkansas Mr. Schwieger was editor of a daily newspaper at Perry, Okla.

C. M. MOSHER has been appointed to the engineering staff of the Edison Electric Institute. Mr. Mosher was formerly with Consolidated Edison System Companies, where for the past 21 years he has been identified with the work of the outside plant construction groups.

ROY N. MAUK, reclamation department, Oklahoma Gas & Electric Co., Oklahoma City, has retired, bringing to a close more than a quarter of a century of service with that utility. Mr. Mauk had been an engineer for the Hennessey Light Co. for four years when Oklahoma Gas & Electric bought the property in 1917. He continued as the local superintendent there for some time, later being transferred to Medford, and in 1933 to Watonga. His many years in the northern division closed with an assignment at division headquarters, Enid, in 1938. The following year he was transferred to the reclamation department, Oklahoma City, where he has been in the transformer section. During his 26 years with Oklohama Gas & Electric Mr. Mauk has seen service in the meter, electric and reclamation departments, serving in a variety of capacities.

DOUGLAS C. TURNBULL, JR., formerly manager of the general service and public relations departments of the Consolidated Gas, Electric Light & Power Co., Baltimore, Md., has been appointed executive assistant of the Baltimore & Ohio Railroad Co.

HERBERT R. WINTERS has been made sales manager of the central division of the Oklahoma Gas & Electric Co. and placed in complete charge of sales activities in that division. O. O. CRUTCHFIELD, who had general supervision over sales activities in this division, will devote his entire time to the sales activities of the Shawnee district.

R. L. MCINTIRE, formerly superintendent of the central division of the Oklahoma Gas & Electric Co., has been appointed superintendent of the Shawnee district to succeed WALLACE GOREE, who is retiring.

CONVENTIONS AND MEETINGS

NOVEMBER

29-30-Dec. 1-3—The American Society of Mechanical Engineers, Pennsylvania Hotel, New York, N. Y.

29-30 Prime Movers Committe, Hotel New Yorker, New York City.

DECEMBER

6-10 National Association of Manufacturers, Waldorf-Astoria Hotel, New York, N. Y.

JANUARY, 1944

24-28 American Institute of Electrical Engineers, New York, N. Y.

FEBRUARY

3-4 Sales Executive Conference, Netherland Plaza Hotel, Cincinnati, O.

APRIL

23-27 National Electrical Manufacturers Association, Chicago, Ill.

MAY

8-11 National Fire Protection Association, Chicago, Ill.

Pennsylvania Electric Association Meeting

(*Continued from page* 348)

were Mary Dahnke, director of the Home Economics Department of Kraft Cheese Company, who spoke on "Meeting Consumer Needs in War Industry," and L. F. Livingston, Agricultural Extension Division, E. I. du Pont de Nemours and Company, whose subject was "How's Your Imagination?"

How does the industry stand with the public and what shall be done about it generally and competitively was discussed in the Business Development meeting at the afternoon session, under the chairmanship of G. A. Gardner, manager of residential sales, Duquesne Light Company. Opinion Research Corporation's Harold D. Read said the public is not antagonistic; it simply doesn't know or is misinformed. The better job that is done in rendering service, the more it is taken for granted. Good service has to be talked about to be appreciated, he said.

Pressly M. McCance, president of the Duquesne Light and newly elected president of the association, then addressed the Section on the subject, "Our Customers Today and Tomorrow." Mr. McCance said that "unless we do something to make the public conscious of the fact that they cannot get any better service anywhere, we will be out of a job." He recommended improvement in job training, employee information, and advertising.

Competition in the future will be more and more exacting as others try to regain lost markets, according to J. F. Gaskill, Philadelphia Electric Company. In preparation, he said, utilities should know their own vulnerability, should acquire knowledge of applications and benefits to customers, and be sure of the proper attitude of customers toward the company and its service. Now is the time to tell customers about service. Also, it is essential that rates, rules and practices be scanned, and that adequate contacts in the period before peace be maintained.

Speaking to the Engineering Section, E. C. Stone, vice-president and general manager, Duquesne Light Company, viewed engineering post-war planning from two angles—namely, competition and coordination with the business program. The construction program, he said, would have to be coordinated with the general business situation to be of greatest value to the community, thus when prices and employment are high, limit construction, and vice versa. Competition can be helped by careful attention to wartime expansion, to possible standards of equipment, maintenance and customers' service cost. Mr. Stone said he looked forward to the post-war period with considerable optimism.

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